

SPM®

Well Service Pumps & Flow Control Products

Full Flow Emergency Relief Valves
Standard Service Models: (Spring Design 3" ERV's)
Operation Instruction and Service Manual

WEIR



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THE FOLLOWING ICONS DENOTE IMPORTANT INFORMATION WITHIN THIS MANUAL.



GENERAL INFORMATION



INSTALLATION AND OPERATION



MAINTENANCE AND REPAIR



SALES AND SUPPORT



NOTE



CAUTION



WARNING/ DANGER



IMPORTANT SAFETY INFORMATION ENCLOSED. READ THIS OPERATING AND MAINTENANCE INSTRUCTIONS MANUAL BEFORE OPERATING PRODUCT.



THIS INFORMATION MUST BE AVAILABLE TO ALL PERSONNEL THAT WILL OPERATE AND MAINTAIN EQUIPMENT. FAILURE TO READ, UNDERSTAND AND FOLLOW THE OPERATING AND MAINTENANCE INSTRUCTIONS MANUAL COULD RESULT IN SEVERE PERSONAL INJURY OR DEATH!

Most SPM® products generate, control or direct pressurized fluids; therefore, it is critical that those who work with these products be thoroughly trained in their proper application and safe handling. It is also critical that these products be used and maintained properly!!

SPM® flow products contain elastomeric seals and are not intended to provide proper functionality when exposed to fire.



MISUSE, SIDE LOADING, IMPROPER MAINTENANCE, OR DISASSEMBLY UNDER PRESSURE CAN CAUSE SERIOUS INJURY OR DEATH!

The following information is given in good faith and should aid in the safe use of your SPM® products. This information is not meant to replace existing Company's safety policies or practices.

Personal Responsibilities:

1. When working on SPM® flow control products, safety glasses, approved safety shoes and hard hat must be worn.
2. Personnel should never hammer on any component when pressure is present. Hammering on any part or component may also cause foreign material or steel slugs to become airborne.
3. It is a personal responsibility to use the proper tools when servicing the valve. It is a personal responsibility to be knowledgeable and trained in the use and handling of tools for all maintenance of the valve.
4. Hot surface may be present; it is a person's own responsibility to protect against burn injury.

On Location:

1. Each valve is clearly marked with a maximum pressure rating. This pressure must not be exceeded or **SERIOUS INJURY OR DEATH CAN OCCUR!**
2. The valve discharge connections should be properly cleaned and lightly oiled before the downstream piping is attached. Any worn, damaged or missing seals should be replaced.
3. Welding, brazing or heating any part of the valve is prohibited. If accessories must be attached, consult Weir Oil & Gas factory prior to installation.
4. A complete visual inspection of the valve must be made prior to each use. Any leaking seals, broken bolts, leaking hoses or improperly tightened parts must be remedied prior to using.
5. Any repairs or service (even routine maintenance) performed on the valve must be performed by a trained service technician who is qualified to work on high pressure flow control valves. All such service and repairs must be supervised by qualified management personnel or returned to Weir Oil & Gas for service. Only SPM® replacement parts should be utilized. Failure to do so may result in loss of warranty as well as **SERIOUS INJURY OR DEATH!**

Special Precautions:

1. The modifications to or unauthorized repair of any part of a SPM® valve, or use of components not qualified by SPM®, can lead to valve damage or failure and **SERIOUS INJURY OR DEATH!**
2. All SPM® threaded components are right hand threaded unless specifically designated otherwise. Any turning counterclockwise will unscrew the assembly. Make sure all threaded components are assembled to the correct torque value.
3. All products should be properly cleaned, greased or oiled after each use and inspected prior to each use.
4. Each integral union connection is clearly marked with a pressure code (i.e. "1502", 15,000 psi). This pressure must not be exceeded. This code should also be used with mating unions. Improper mating can result in failures. All integral union connections used must match (according to size, pressure rating, etc.). These connections must also match the service of the designated string they are installed in.



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SECTION I: General Information

This service manual covers:

2A22462	RELIEF VA/3-1502MXF/5K/FULL FLOW/SPRING
2A23275	RELIEF VA/3-1502MxF/10K/FULL FLOW/SPRING
2A22356	RELIEF VA/3-1502MxF/15K/FULL/SPRING

Rebuild Kits:

Full Kit (Includes all below except Fasteners Kit)	
4L22486	Full Kit for 15K NSCWP
4L22483	Full Kit for 5K/10K NSCWP
Spring Kits	
4L22484	Springs – 30 Per Kit – For 5K NSCWP
4L23034	Springs – 30 Per Kit – For 10K/15K NSCWP
Seal Kits	
4L22491	Seal Kit (all seals) – For 5K/10K NSCWP
4L22482	Seal Kit (all seals) – For 15K NSCWP
Gate, Nozzle & Seal Kits	
4L22485	Valve Gate, Discharge Nozzle & Discharge Nozzle Seal – For 5K NSCWP
4L22481	Valve Gate, Discharge Nozzle & Discharge Nozzle Seal – For 15K NSCWP
Fasteners (Bolts) Kit	
2A40964	Fastener Kits – Bolts for top and bottom Assembly – All 3” Relief Valves

Product Description:

SPM[®] Emergency Relief Valve provides overpressure protection for reciprocating pumps, treating lines, pressure vessels, and other equipment operating under high pressure, high flow conditions. Compact and simple to operate, the valves are direct acting, relying on the system's hydraulic pressure to overcome a preset spring force to relieve. They are externally adjustable from zero pressure to maximum setting.

Unlike shear relief valves, which use common nails to trigger the release, the SPM[®] valves will reseal once the system pressure reduces. And unlike many "High-Lift" Valves, which require a substantial drop in pressure before they will reseal, the SPM[®] relief valve exhibits little blowdown and will reseal at or near the "cracking pressure."

Manufactured to SPM[®] stringent Quality Assurance System, all pressure bearing components are made from high quality material. The forged body features an integral wing union male inlet, suitable for the pressure rating of the component.

The low pressure outlet is available with an integral wing union female connection. Conforming to conditions of design and performance in API RP520, the SPM[®] Emergency Relief Valves are intended for liquid service. They are not intended for elevated temperatures or as a safety device in case of fire.

Available in 2" and 3" sizes, these valves offer pressure ranges from 0 PSI to 15,000 PSI. The valves are best suited for over pressure protection in a "slick water" medium. (See 2" Emergency Relief Valve Service Literature for information regarding the 2" E.R.V)



DO NOT USE FOR H2S SERVICE!



General Description of Relief Valve Operation:

The SPM® Back Pressure Relief Valve's operation is a simple balance between the spring loaded keeper which holds the gate on the nozzle and the inlet liquid pressure acting on the gate.

The spring pressure is set by tightening the Hex Bolt on top which pushes on the keeper which in turn compresses the Belleville springs that forces the gate on the nozzle. When the inlet fluid pressure rises and overcomes the set spring pressure, the gate is lifted off the nozzle thereby discharging fluid to the outlet end. Once the pressure of the inlet fluid falls below the set spring pressure, the gate will be pushed back on to its seat and the fluid can pass downstream.

End Connection Options:

The SPM® 3" Emergency Relief Valves are available with SPM® wing union connections. The nameplate will indicate the cold working pressure allowable for each assembly.

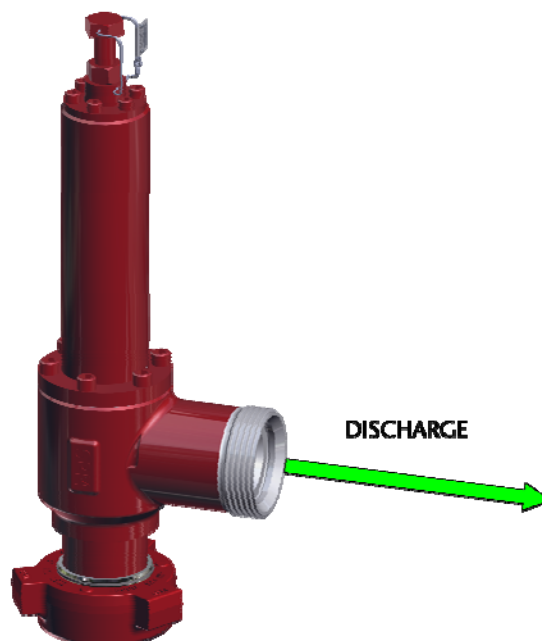
SPM® wing union connections on the relief valves are interchangeable with other union connections of the same size and figure (pressure rating). Caution must be taken to avoid mixing different ratings of wing connections. There are various sizes and figures that are capable of making marginal connections. Failure to observe good judgment may lead to failure of components and danger to life and limb. Always verify working pressure ratings of each connection before use.

This device is intended to discharge to atmospheric pressure when it relieves. It should not be subjected to any significant back pressure. The choice of discharge connections is offered as a convenience for the user and does not imply high pressure capability.



WARNING: OBSERVE ALL INSTRUCTIONS, CAUTIONS AND WARNINGS AS NOTED IN THIS MANUAL. FAILURE TO DO SO CAN LEAD TO EQUIPMENT DAMAGE AND PERSONAL INJURY OR DEATH!

Figure 1





SECTION II: Installation and Operation

Installation:

The SPM® Relief Valve should be installed in a branch on the high-pressure pump line (Figure 1). To avoid stability problems, the valve **should not** be mounted directly at the pump discharge, but rather somewhat removed from the pump due to the fluctuating discharge signature of the pump. The valve should be mounted in the vertical position as shown, to reduce the tendency for contaminants and particulates in the fluid to collect at the throat of the nozzle.

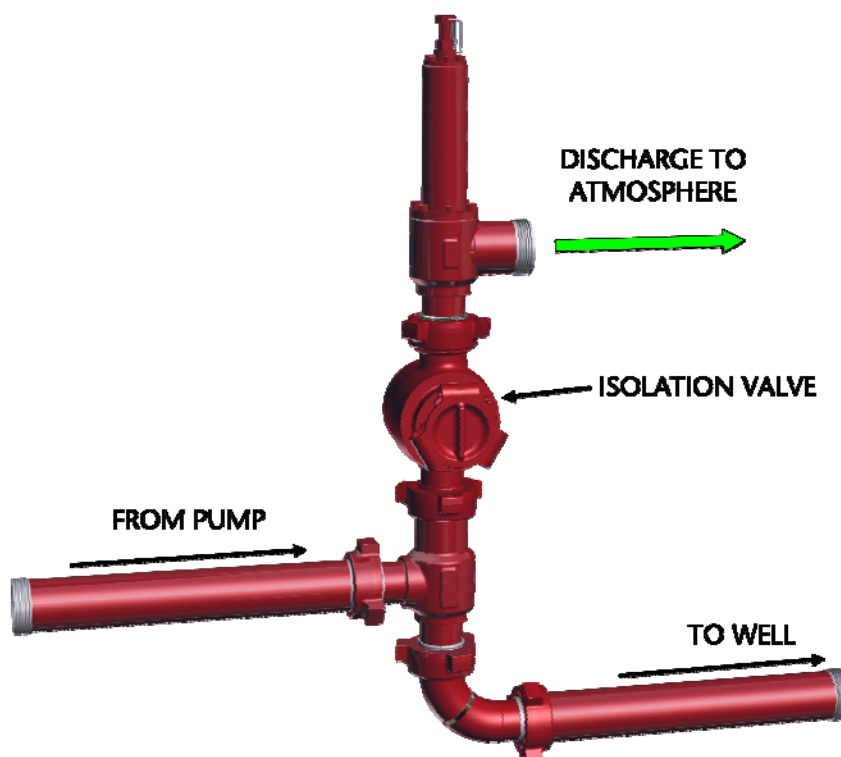
Although, any type of fluid may be relieved through the valve, the slick water media will allow for reseating (and therefore resealing); whereas propants may become trapped in the valve gate and nozzle sealing area and inhibit resealing. This is also true of contaminants.



IT IS IMPORTANT FOR THE USER TO CONSIDER THE CONSEQUENCES OF A VALVE THAT DOES NOT FULLY RESEAT AFTER IT HAS RELIEVED. IN THE EVENT THAT THIS MIGHT PRESENT A DANGER TO PERSONNEL OR EQUIPMENT, SPM® HIGHLY RECOMMENDS THAT AN ISOLATER VALVE BE PLACED BETWEEN THE PRESSURE LINE AND THE RELIEF VALVE.

With the device installed (Figure 2); any time the pressure exceeds the set pressure at the relief valve, the fluid will pass through the valve and out the discharge.

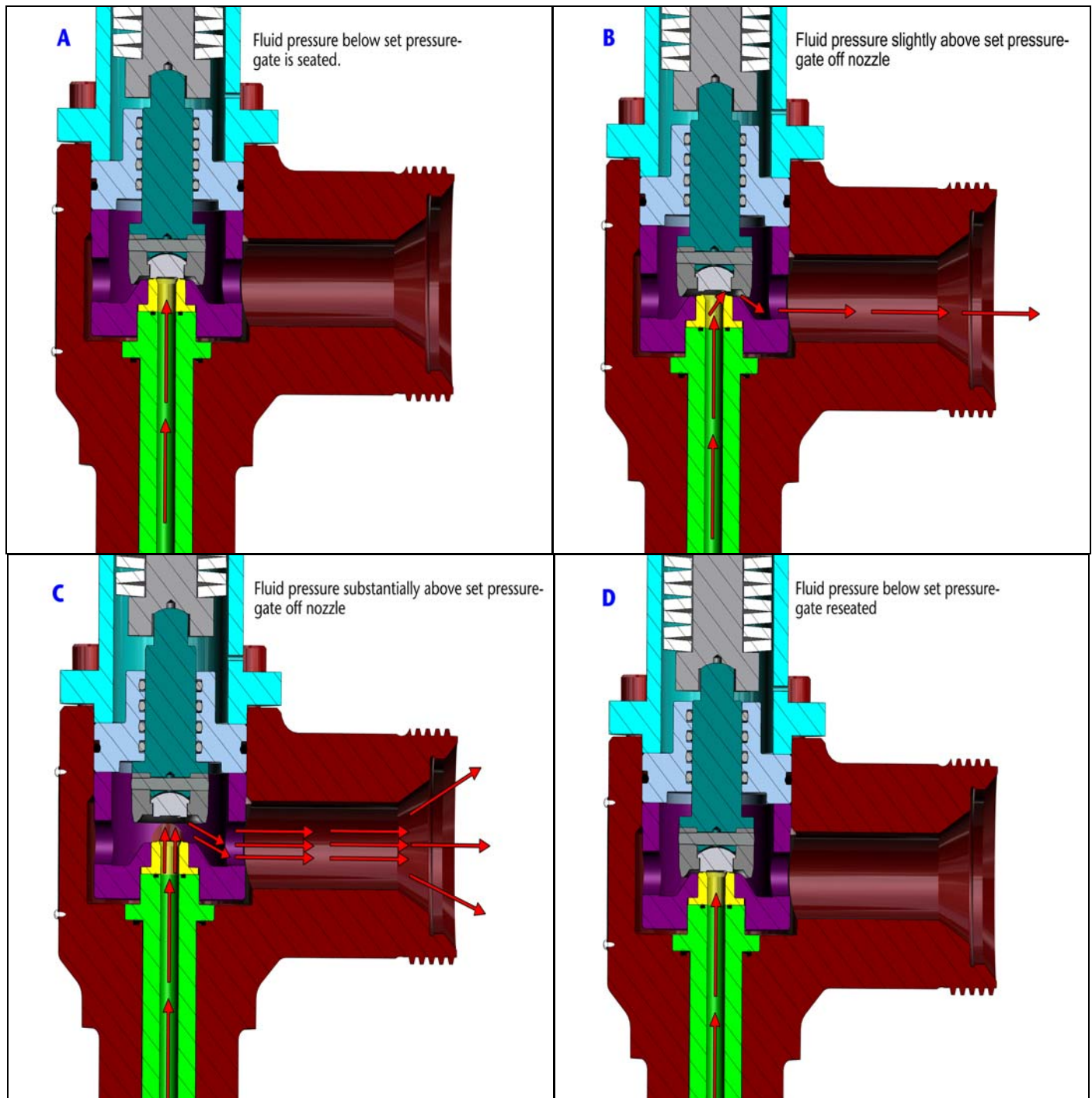
Figure 2



Installation (Cont.):

At low flow rates, the valve will discharge fluid at approximately the set pressure Figure 2 (A through D). At higher flow rates, the valve will discharge fluid at levels above the set pressure. API 520 defines the valve flow capacity as the rate that can be relieved at an over pressure of 25%. When the fluid pressure falls to the set pressure level or below, the valve will reseal and reseal.

Figure 3



Calibration Guide:

Refer to page 38.

Pressure/ Temperature Ratings:

The SPM® 3" Spring loaded Full flow Emergency Pressure Relief Valve is available in the following configurations at this time.

INLET	(LOW PRESSURE DISCHARGE)	PRESSURE RANGE, PSI	INT. END NSCWP	SERVICE	SEAL TEMP RANGE
3" – 1502M	3" – 1502F	0 - 5000	15000	STANDARD	-30 C -110 C
3" – 1502M	3" – 1502F	0 - 15000	15000	STANDARD	-30 C -110 C



SECTION III: Maintenance and Repair



WARNING: DISASSEMBLY UNDER PRESSURE CAN CAUSE SERIOUS INJURY OR DEATH!

Always Remember:

1. Always wear PPE (personal protective equipment).
2. Only qualified technicians should perform maintenance on SPM® products.
3. Always use SPM® supplied new parts kit for reassembly.
4. Clean all components thoroughly prior to reassembly.
5. Check sealing surface area of valve gate and nozzle for pitting, erosion or other flaws. Failure in sealing can result if these areas are not smooth.
6. Use only SPM® Relief Valve parts on SPM® Relief Valves.
7. This device is intended to discharge atmospherically when it relieves.

ID	REQUIRED TOOLS	ID	REQUIRED TOOLS
A	TORQUE WRENCH	I	FLAT HEAD SCREWDRIVER
B	5/8" ALLEN SOCKET	J	3/16" PIN PUNCH
C	1/2" ALLEN SOCKET	K	MOLY LITHIUM GREASE
D	SAFETY GLASSES	L	VICE WITH ALUMINUM JAWS
E	600G SAND PAPER	M	STANDARD ALLEN WRENCH SET
F	PROTECTIVE GLOVES	N	LPS LAB. #02910 COPPER BASED ANTI-SEIZE OR EQUIV.
G	HAMMER	O	1-1/2" OPEN END WRENCH
H			
I			
J			
K			
L			
M			
N			
O			



Maintenance Requirements:

The SPM® 3 inch or 4 inch Emergency Relief Valve is a well-designed, dependable valve that provides long term reliable performance. Like any device, however, it requires routine inspection and servicing to guarantee that it is fully functional. Due to the harsh field environment where this relief valve will be used, it is imperative that maintenance of this valve be HIGH Priority to ensure repeatability.

SPM® recommends that the valve be serviced during the following:

1. Preventative Maintenance (After 20 Fracturing Stages, or 1 Complete Frac Job)

Any time the valve is sequenced in operation as a result of overpressure (other than routine calibration with clean water prior to pumping operations), it must undergo a teardown and the primary seal surfaces be inspected. If no over-pressure event occurs, the valve shall be serviced after every 20 stages or 1 frac job, whichever comes first. This should be done immediately following the completion of the current job.

Not properly servicing the valve once it has discharged frac media (including frac sand) is a dangerous practice and increases the risk of leakage during the next operation. Disassembly, repairs, and reassembly should be done in accordance with service manual instructions.

The valve's design allows for a quick and easy inspection of its internal components. The components that require inspecting are listed below and are referenced on the bill of materials on page 16. (Illustrated on pages 17-19):

(The kits that provide all needed components for preventative maintenance are as followed:

- Gate/Nozzle Kit – (Reference Page 6 and 14 for correct kit) – **Replace Components**
- Fastener Kit – (Reference Page 6 & 14) – **Replace if needed**

* SPM fasteners are designed to endure multiple inspection intervals. However, damage can occur if the fasteners are over-torqued or exposed to improper operational procedures. Due to this, SPM® recommends that all critical fasteners be replaced on a periodic basis. The recommended inspection interval is a function of the severity of use; however the replacement interval should not exceed three (3) months.

Disassembly/Inspection guidelines are on pages 20 through 29.

2. Annually Inspection

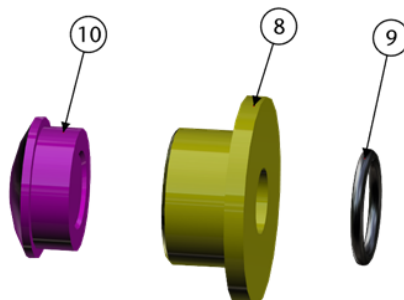
An annual inspection is required to ensure that all internal components of the valve are working properly and are to SPM® Engineering's specifications. It is imperative that a qualified SPM® Technician follow the assembly/disassembly/inspection instructions illustrated on pages 20 through 36. **For Annual maintenance inspection the following kits will be needed to replace all existing parts (regardless of their condition):**

1. Parts Kit
2. Spring Kit
3. Fastener Kit

(Part Kits referenced/Illustrated on Page 14, and 15)

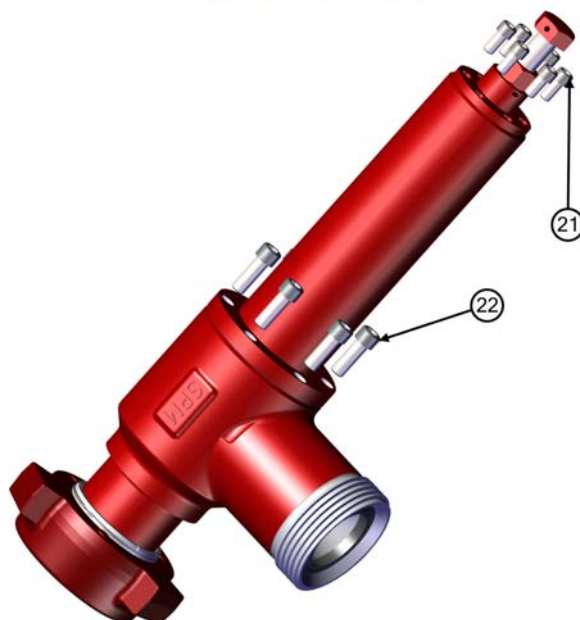
Preventative Maintenance Requirements (Cont.):

Regular maintenance spare parts. Item #8, 9, and 10



RELIEF VA PART NO	PRESSURE (PSI)	KIT PART NUMBER	ITEM NO #8 Discharge Nozzle	ITEM NO #9 (Discharge Nozzle Seal)	ITEM NO #10 Valve Gate
2A22462	5,000	4L22485	3P22375	P22508	3P22506
2A23275	10,000	4L22485	3P22375	P22508	3P22506
2A22356	15,000	4L22481	3P22364	P19050	3P22363

Items # 21 and #22

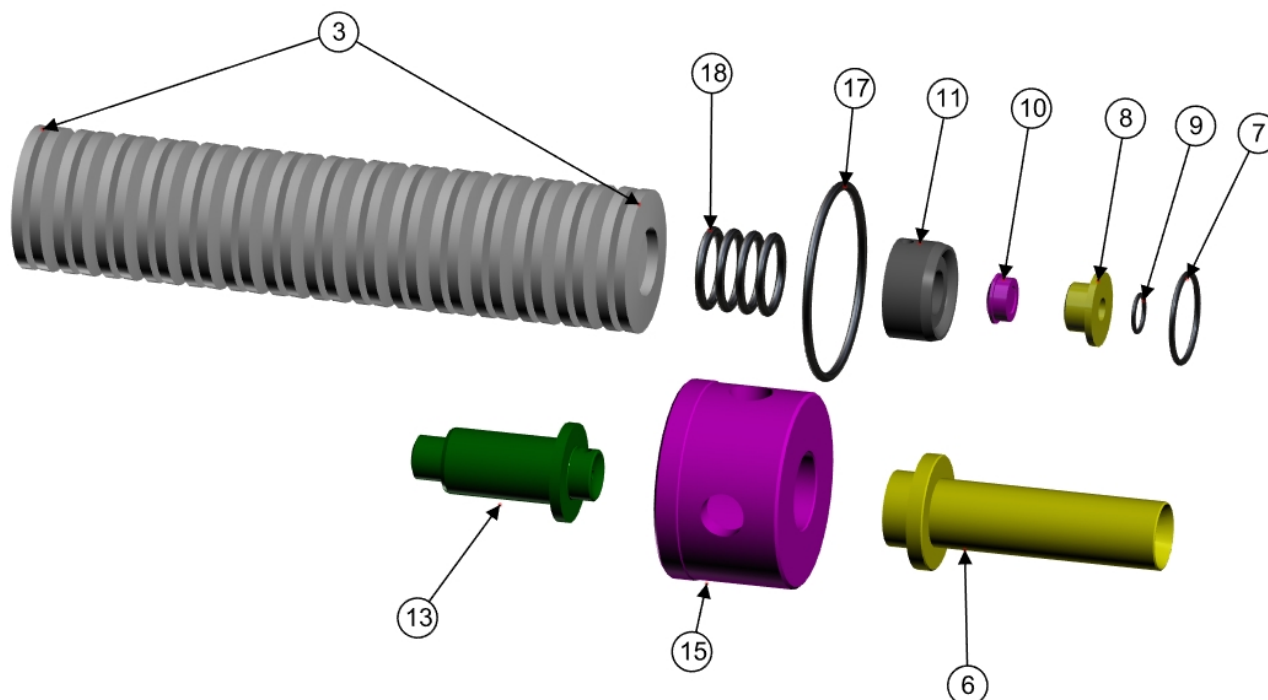


RELIEF VA PART NO	PRESSURE (PSI)	KIT PART NUMBER	ITEM NO #21 (TOP FASTENERS)	ITEM NO #22 (BOTTOM FASTENERS)
2A22462	5,000	2A40964	P12657	P23863
2A23275	10,000		P12657	P23863
2A22356	15,000		P12657	P23863

ANNUAL MAINTENANCE SPARE PARTS

All elastomeric seals need to be replaced regardless of condition: Item #7, 9, 17, 18

Expendables: Item #8, 10, 11, 3, 13, 15, 6



1. PARTS KIT

RELIEF VA PART NO	PRESSURE (PSI)	KIT PART NO	ITEM #7	ITEM #9	ITEM #17	ITEM #18	ITEM #8	ITEM #10	ITEM #11	ITEM #6	ITEM #13	ITEM #15
2A24962	5,000	4L22483	P100807	P22508	P16637	P11712	3P22375	3P22506	3P22461	3P22373	3P22358	3P22368
2A23275	10,000											
2A22356	15,000	4L22486	P100807	P19050	P16637	P11712	3P22375	3P22506	3P22461	3P22367	3P22358	3P22368

2. FASTENER KIT (Illustrated on page 14)

RELIEF VA PART NO	PRESSURE (PSI)	KIT PART NO	ITEM #21	ITEM #22
2A24962	5,000	2A40964	P12657	P23863
2A23275	10,000			
2A22356	15,000			

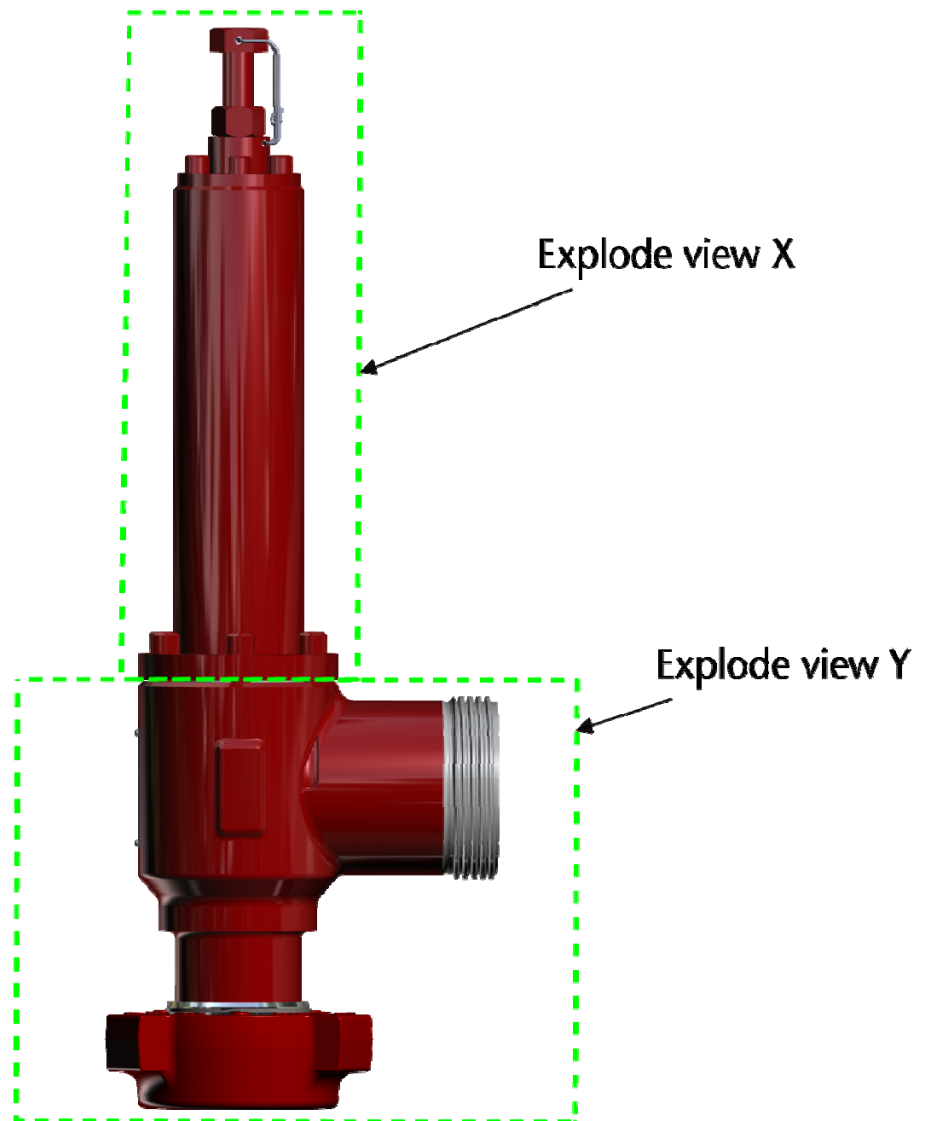
3. SPRING PACK KIT

RELIEF VA PART NO	PRESSURE (PSI)	KIT PART NO	ITEM #3
2A24962	5,000	4L22484	P22362
2A23275	10,000	4L23034	P22468
2A22356	15,000		

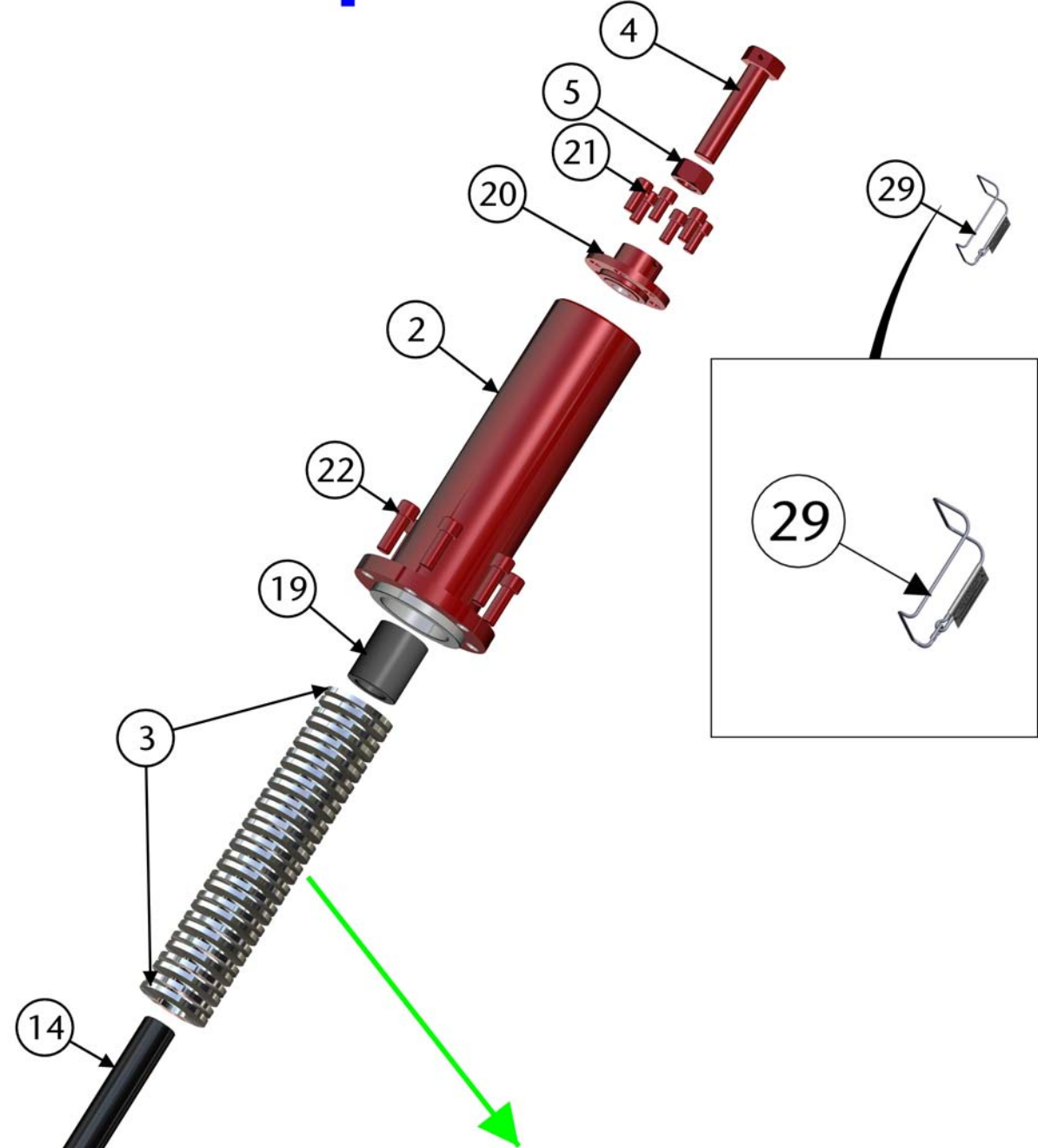


2A22356 BOM TABLE			
BOM ID	QTY	PART NUM	DESCRIPTION
1	1	2P22357	BDY/RELIEF VA/3-1502MXF/FULL FLOW
2	1	2P23033	CAP/3 RLF VA/15KFULLFLOW
3	30	P22362	DISK SPRING, RELIEF VALVE, STEEL, NICKEL PLATED
4	1	P23280	SCRW/HHCS/1.00-14UNS X 4.50.11-.13 DIA. HOLE
5	1	P22478	NUT/HEX/1.00-14UNS
6	1	3P22367	NZZL/FIXED/3 RLF VA/15K/FULL FLOW
7	1	P100807	O-RING, 2-225, BUNA N 90 DURO
8	1	3P22364	NZZL/DIS/3 RLF VA/15K/FULL FLOW
9	1	P19050	O-RING, 2-116, BUNA N 70 DURO
10	1	3P22363	GATE/3 RLF VA/FULL FLOW/15K
11	1	3P22461	KEEPER/GATE/3 RLF VA/FULL FLOW
12	1	P22479	#5 TAPER PIN X 2.25 LG
13	1	3P22358	KEEPER/3 RLF VA/LWRFULL FLOW
14	1	3P23031	KEEPER/3 RLF VA/UPR/15K/LONGFULLFLOW
15	1	3P22368	SPDR/3 RLF VA/UPR/LO-TMP/NITRO/FULL FLOW
16	1	3P23162	SPDR/3 RLF VA/UPR/LO-TMP/NITRO/FULL FLOW
17	1	P16637	SEAL/OR41345019
18	4	P11712	SEAL/OR15018819/BUNA N 90 DURO
19	1	3P23032	GUIDE/BSHNG/3 RLF VA/15KFULL FLOW
20	1	3P22877	FLNG/ADJ/3 RLF VA/15KFULL FLOW
21	6	P12657	SCRW/SHCS/ .50-13UNC X 1.00
22	6	P101915	SCRW/SHCS/ .63-11UNC X 1.75
23	1	4P18295	NAMEPLT/RELIEF VA
24	2	P18055	SCRW/DRV/4 X 3/16/TYP E U
25	1	2P10257	WING NUT/ 3-1502/PSL LVL3
26	3	3P10260	RET SEG/3-602/1002/1502
27	1	P10261	RET RNG/3-602/1002/1502
28	1	4P10258	SEAL RNG/UNION/3in
29	1	2A23316	FACTSEALINST/RELIEFVA/3FFOPTION #1

BOM/ Exploded View

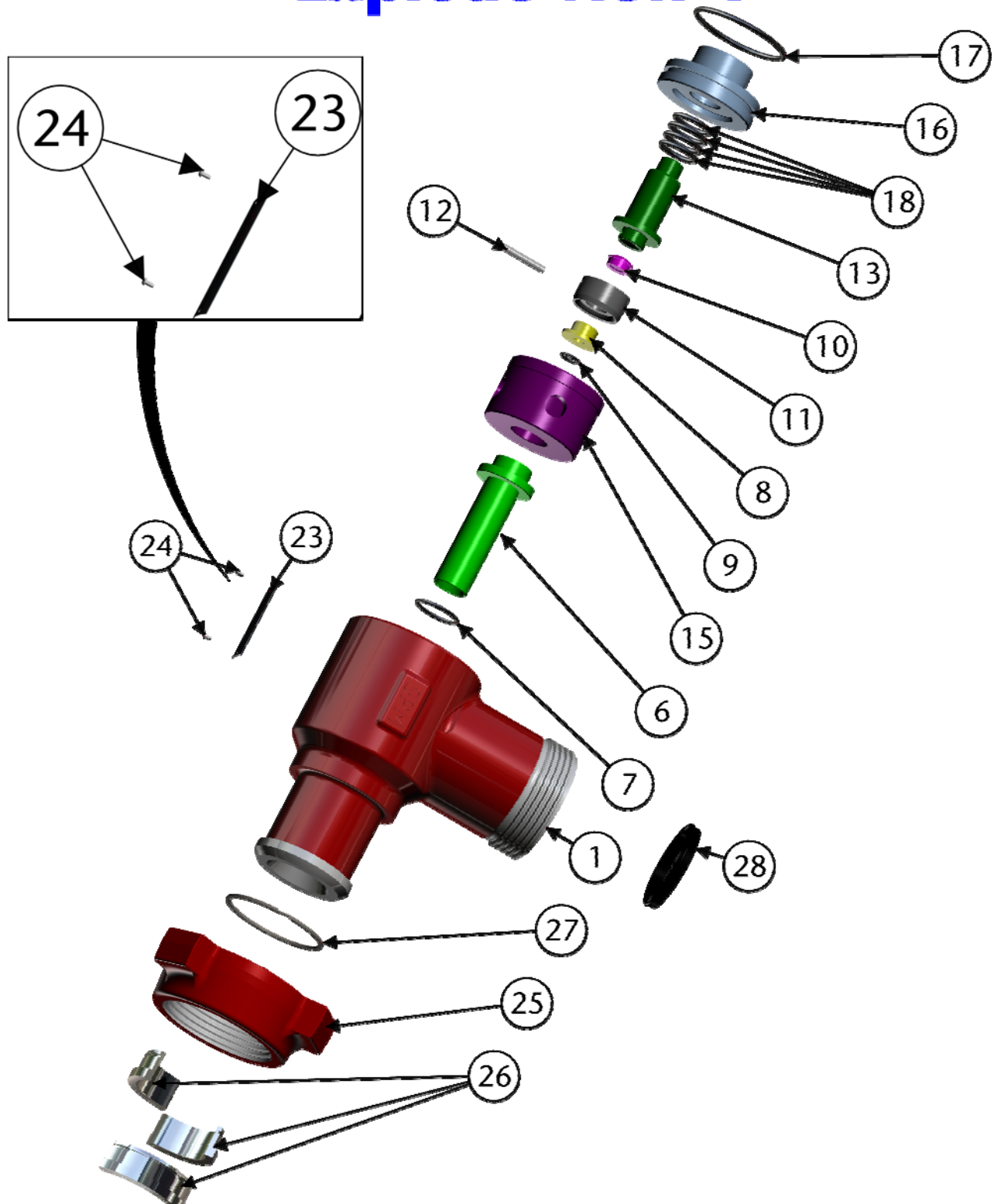


Explode view X



	SPRING PACK "A"	SPRING PACK "B"
QUANTITY	Thirty (30) pcs	Thirty (30) pcs
SET PRESSURE RANGE:	0-15000 PSI	0-5000 PSI
APPLICATIONS	3" - 1502, 4" - 1002	3" - 1502, 4" - 1002

Explode view Y



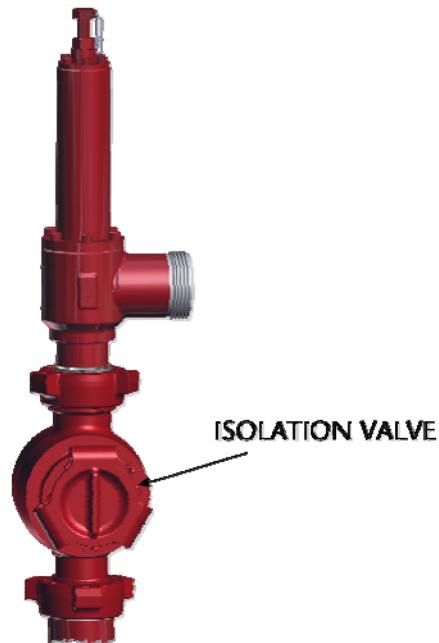
Preventative Maintenance and Disassembly:



ENSURE ALL PRESSURE IS RELIEVED PRIOR TO PERFORMING ANY MAINTENANCE OR DISSASSEMBLY!

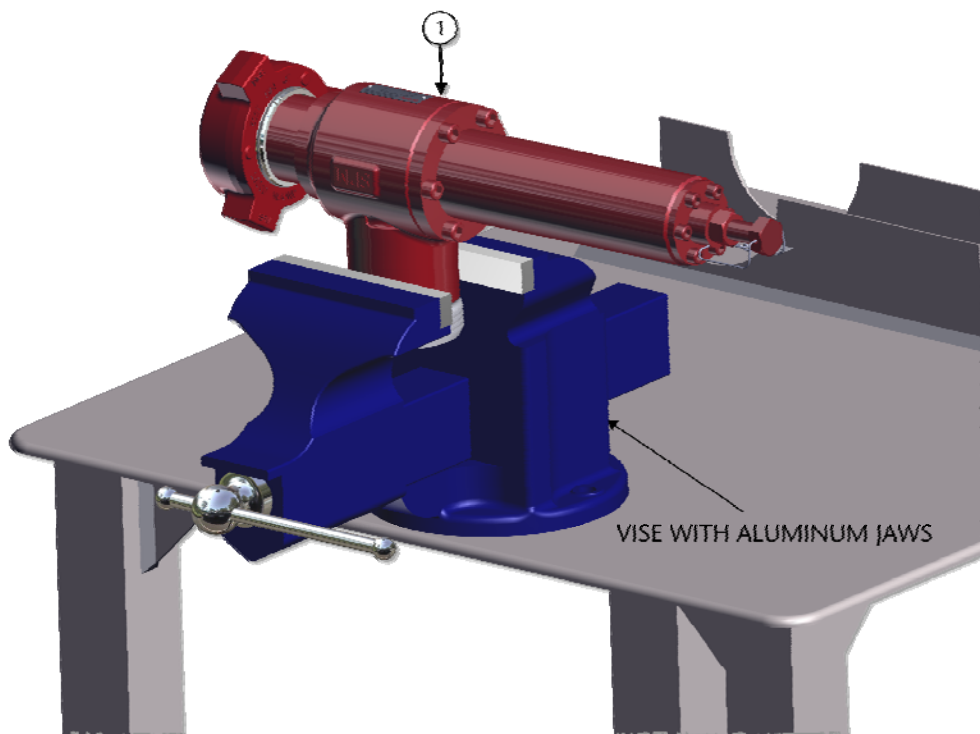
STEP 1

Close isolation valve to shut off fluid pressure. Detach and remove spring loaded ERV from system.



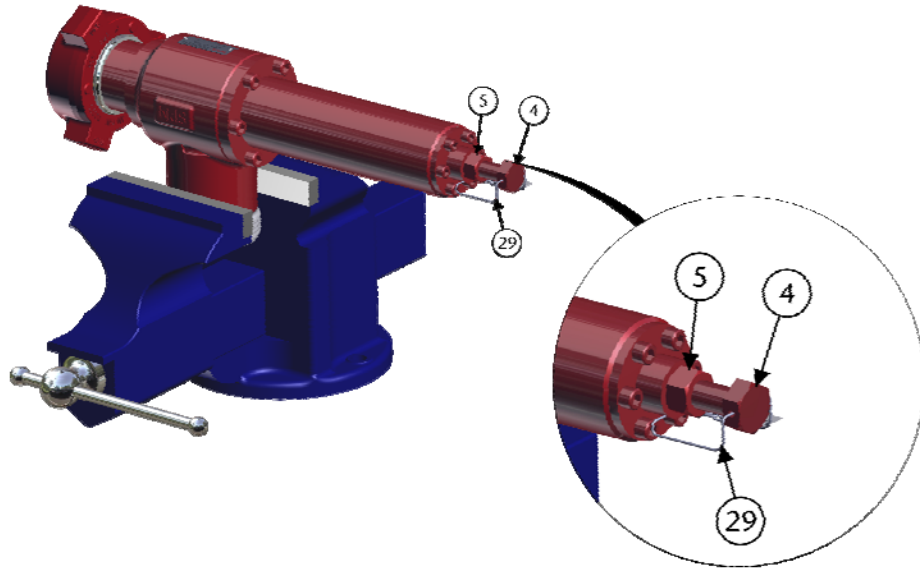
STEP 2

Secure the valve in a horizontal position by clamping the valve body (1) in a vise with aluminum jaws.



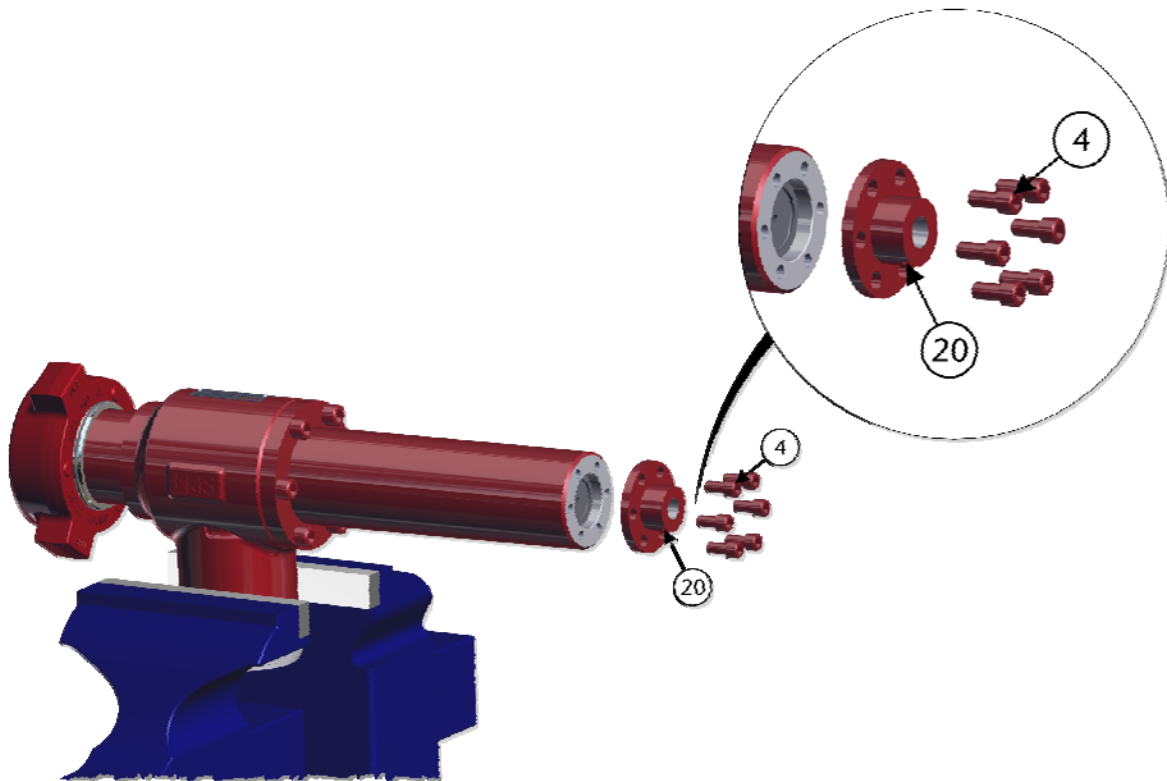
STEP 3

Remove the factory seal (29). Loosen the hex lock nut (5). Remove the adjusting screw (4) with the locknut (5).



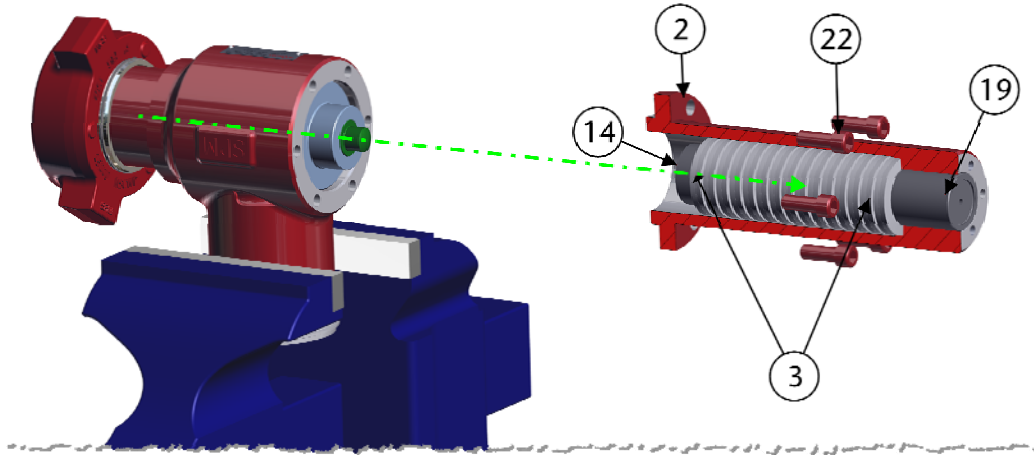
STEP 4

Remove the six screws (21) and the flange (20).



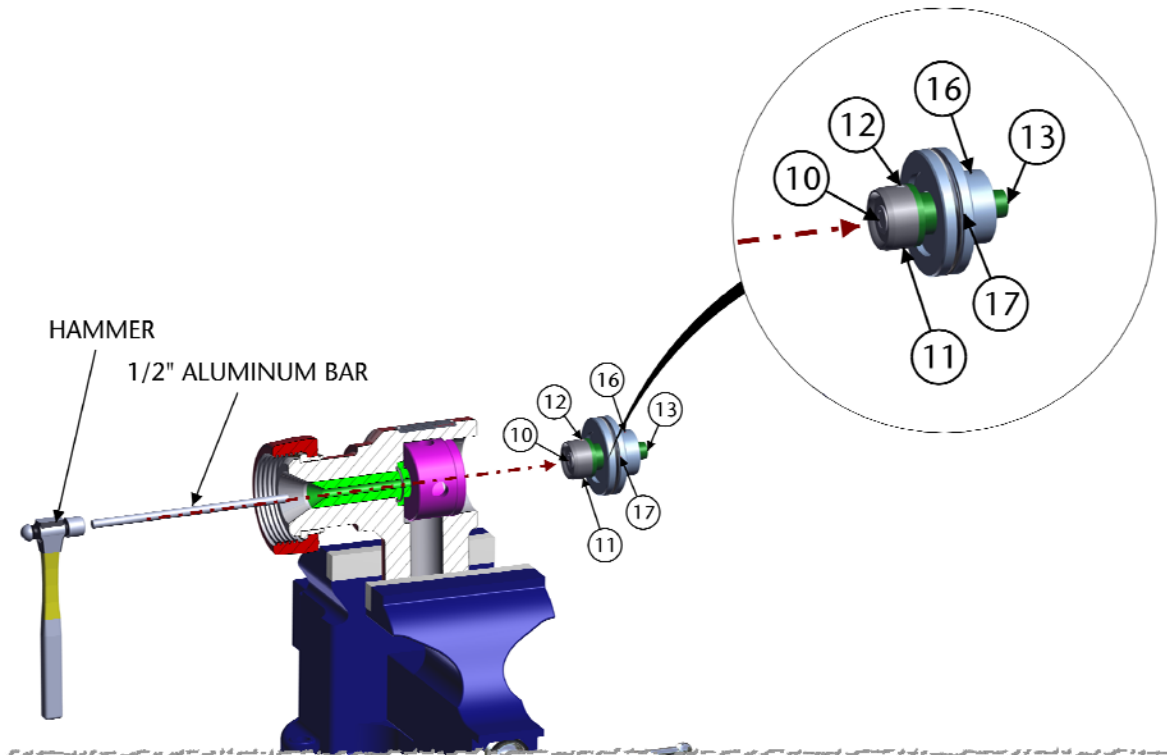
STEP 5

Remove the six screws (22) with the cap (2), the keeper- upper (14), the springs (3), and guide bushing (19). As the cap (2) is removed, the guide bushing (19), the keeper-upper (14), and the springs (3) will be removed with it.



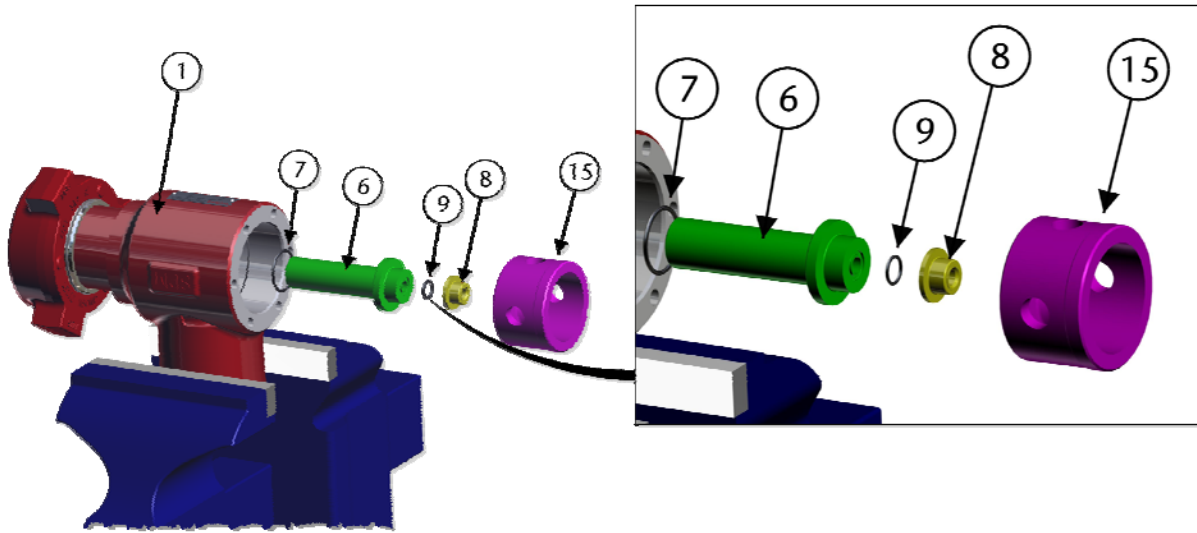
STEP 6

Using the 1/2" diameter aluminum bar and hammer; remove the spider – upper (16) jointly with the keeper – lower (13), the gate keeper (11), and valve gate (10), and the taper pin (12).



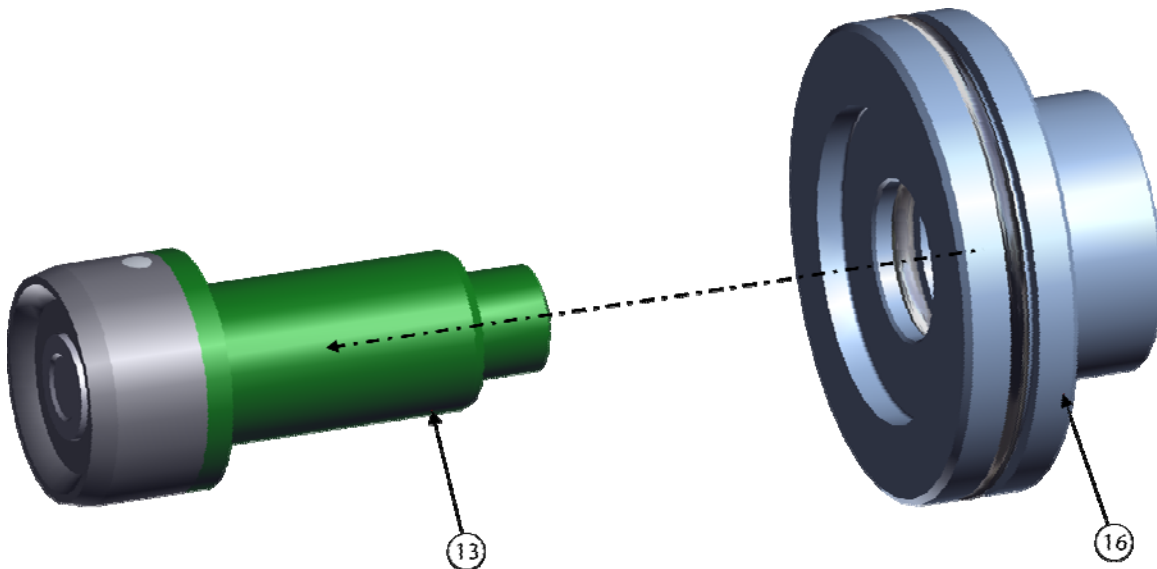
STEP 7

Remove the spider lower (15), the discharge nozzle (8), and the fixed nozzle (6) from the valve body.



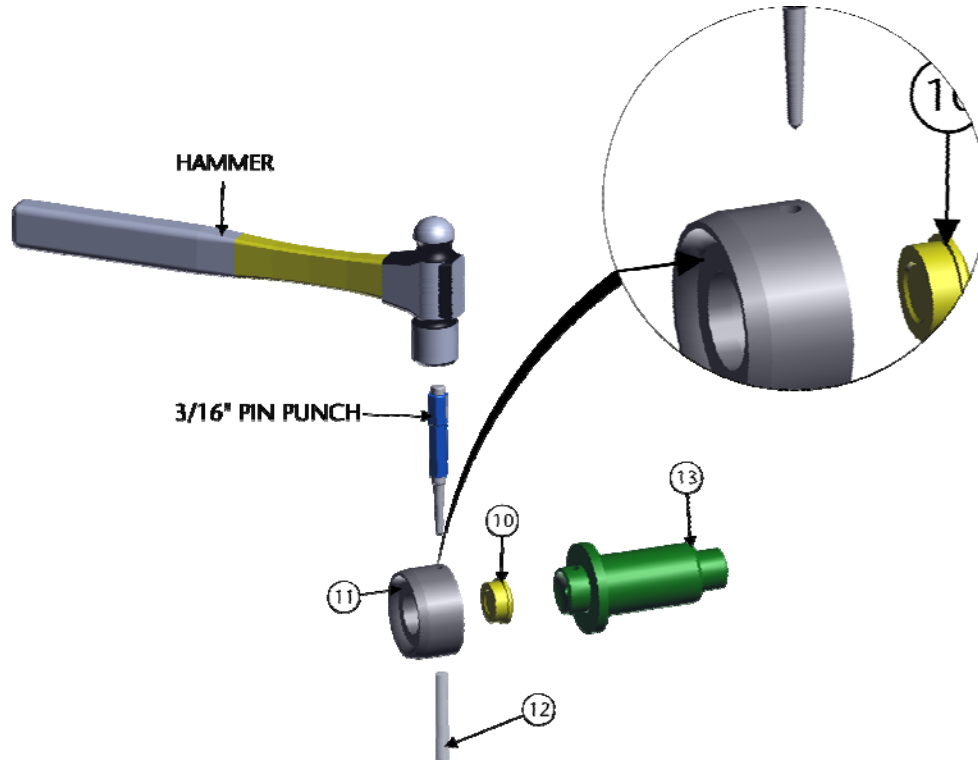
STEP 8

Remove the keeper-lower (13) from the spider – upper (16).



STEP 9

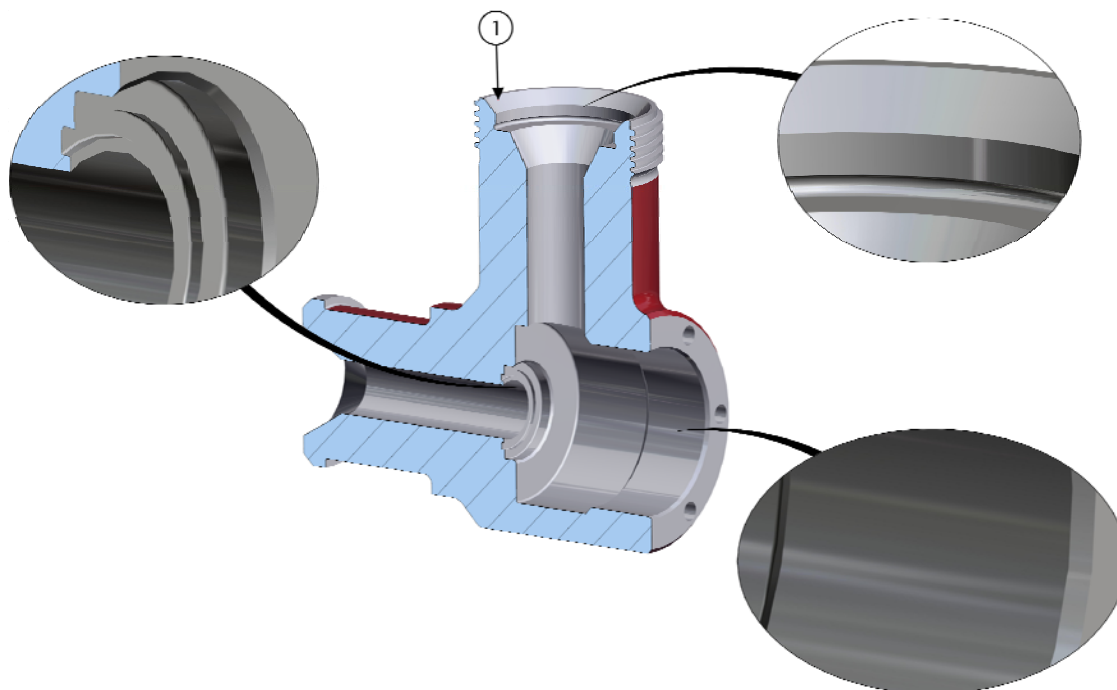
Using the 3/16" pin punch, remove the taper pin (12). Once the taper pin (12) is removed, the valve gate (10) may be removed from the keeper- lower (13).



Preventative Maintenance - Inspecting Internal Components:

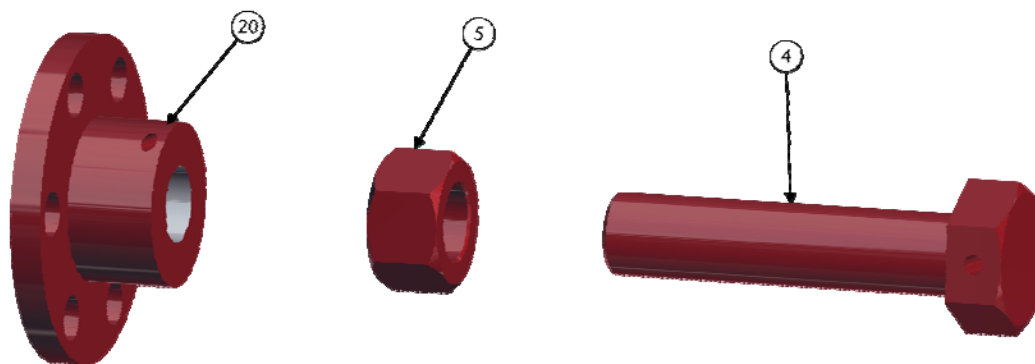
BODY

Visually inspect the o-ring groove. If this area shows any indication of damage from either erosion or corrosion, the body must be replaced. Visually inspect the fluid discharge surface for erosion or corrosion. Some wear in this area is expected. Any damage in excess of .10" renders the body unusable. Visually inspect the spider-upper seal surface for erosion or corrosion. Damage to this area will allow fluid to leak past the cap during the relieving function. If this surface shows signs of damage; replace body



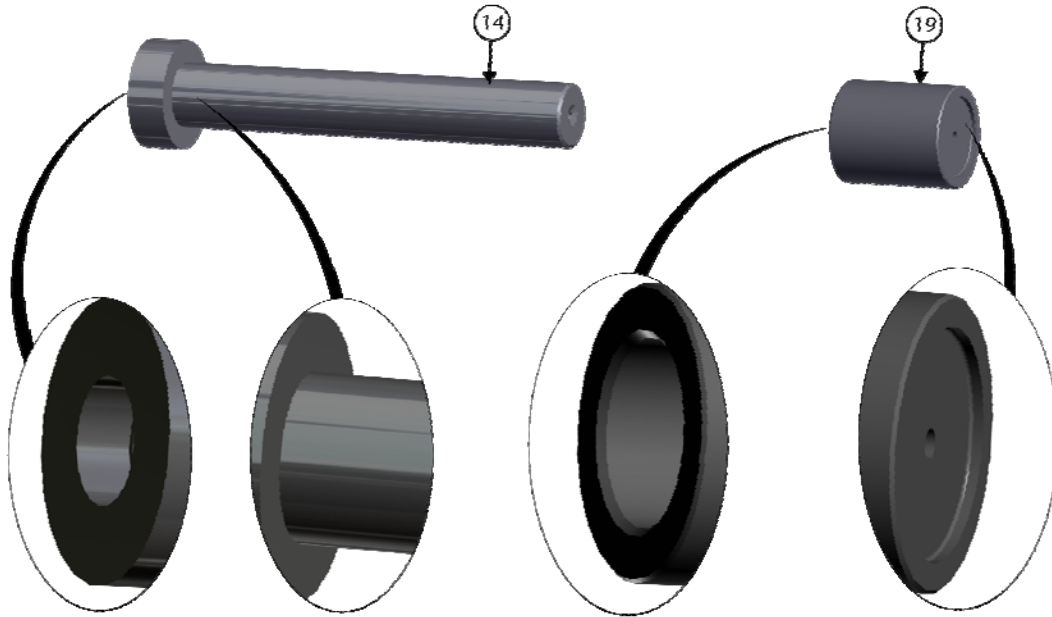
FLANGE (20), ADJUSTING SCREW (4), LOCK NUT (5)

Visually inspect the adjusting screw threads and mating threads in the flange (20) for indications of damage or wear. Lubricate the adjusting screw (4) and engage it into the flange (20) by hand. The action should be free and easy. Damage to the flange threads or adjusting screw render these components unusable and they must be replaced.



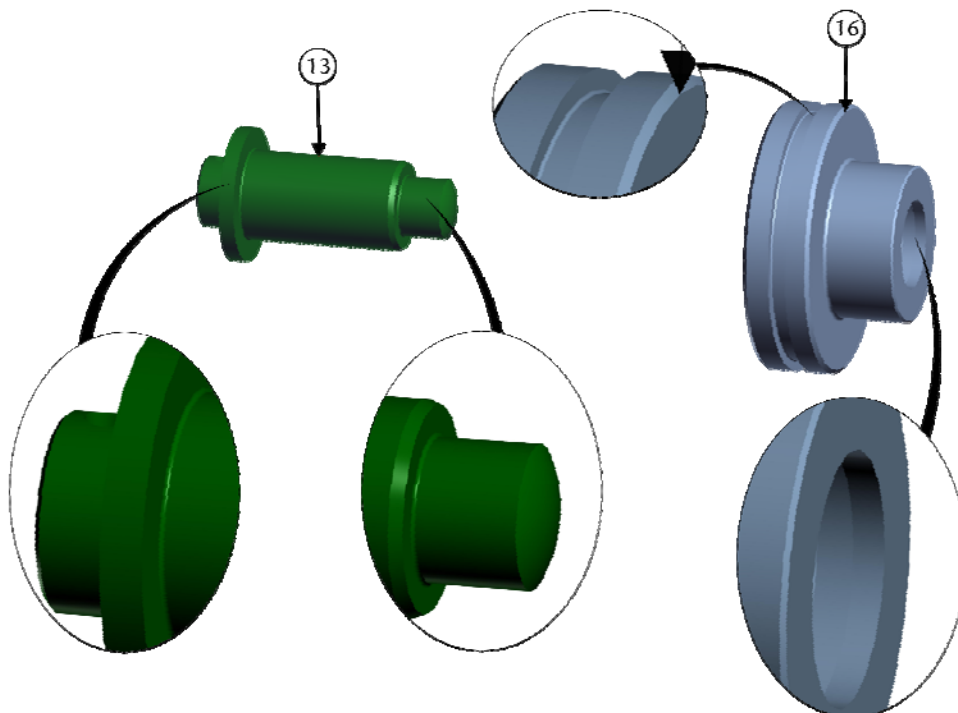
GUIDE BUSHING (19), AND KEEPER-UPPER (14)

Visually inspect the Guide bushing (19) and the Keeper-upper (14) friction surfaces for indications of damage or wear. Visually inspect the keeper-upper (14) disk spring support area for damage due to damage or wear. Visually inspect the keeper-upper (14) disk spring support area for damage due to disk springs. Inspect hole diameter and mating surface of keeper-upper for wear or damage. If damage or wear is evident, the parts must be replaced.



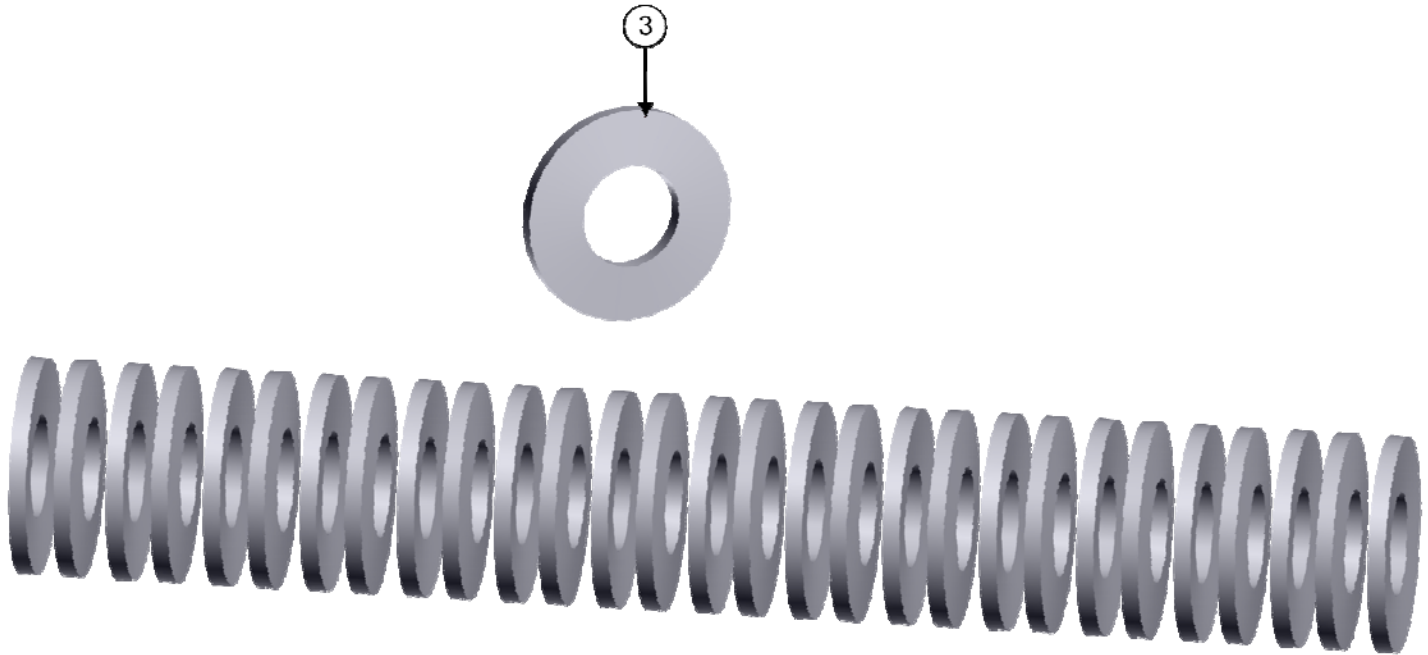
KEEPER-LOWER (13) AND SPIDER-UPPER (16)

Visually inspect the keeper seal area and spider seal surfaces for signs of wear or damage. Visually inspect the keeper- upper mating surface for unusual dents or damage. Replace these parts if damage or wear is evident.



DISK SPRINGS (3)

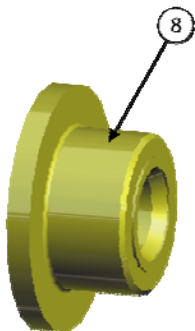
Visually inspect the keeper seal area and spider seal surfaces for signs of wear or damage. Visually inspect the keeper- upper mating surface for unusual dents or damage. Replace these parts if damage or wear is evident.



VALVE GATE (10) AND DISCHARGE NOZZLE (8)

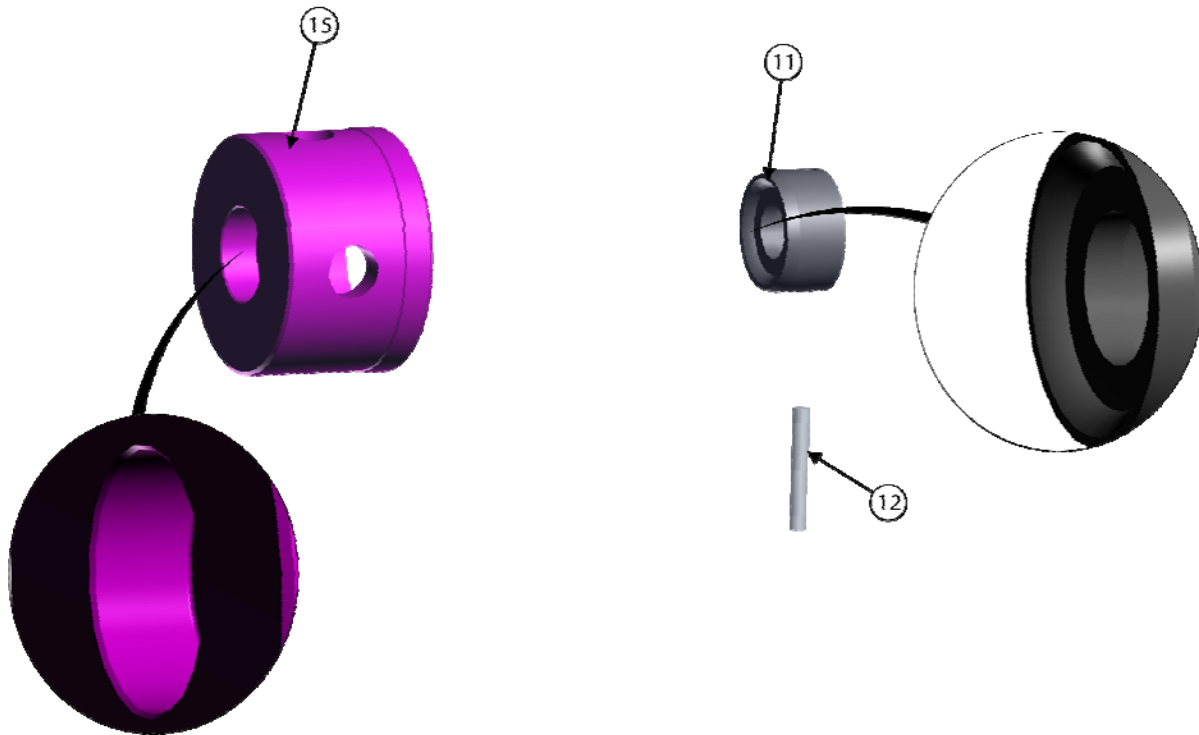
The gate and nozzle are considered expendable items and spares should be kept on hand at all times. The life of these parts are dependent on the type and length of service to which they are exposed. Visually inspect the gate and nozzle for indications of wear and of pitting, erosion or corrosion damage. These are critical components in the function of the valve. Any indications of deterioration more than .01" deep should be cause to replace these items.

Deterioration of the sealing surfaces less than .01" deep should be removed by polishing with 600 grit sandpaper. Keep flatness of surface when polishing. Total depth of polishing should not be more than .015" for each sealing surface. Look for contaminants that, while not damaging to the gate and nozzle, will keep the parts from sealing. Remove any foreign material found.



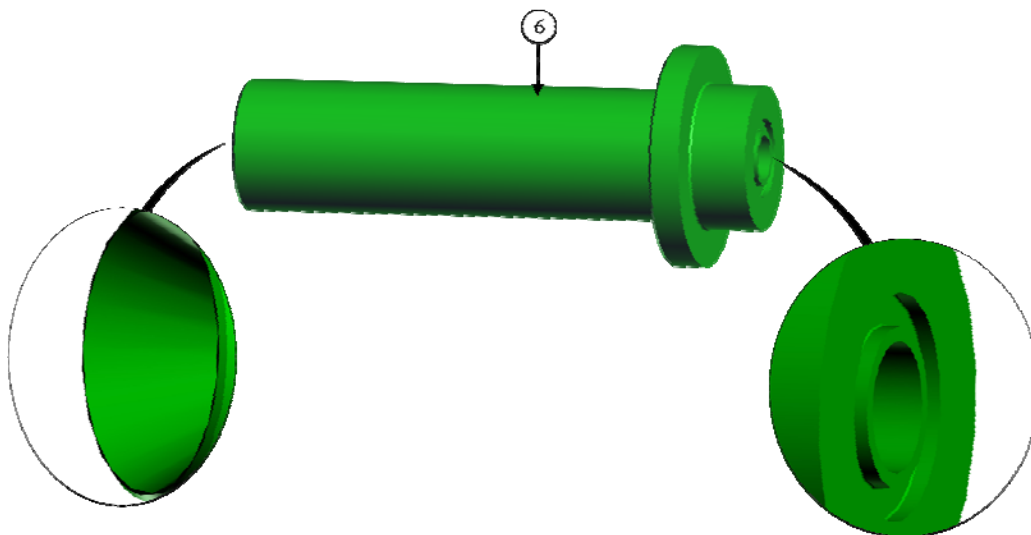
SPIDER-LOWER (15) AND GATE KEEPER (11)

Visually inspect the fluid discharge areas for erosion and corrosion. Some wear in these areas are expected. Any damage in these areas that extend deeper than .06" renders the parts unusable and they should be replaced.



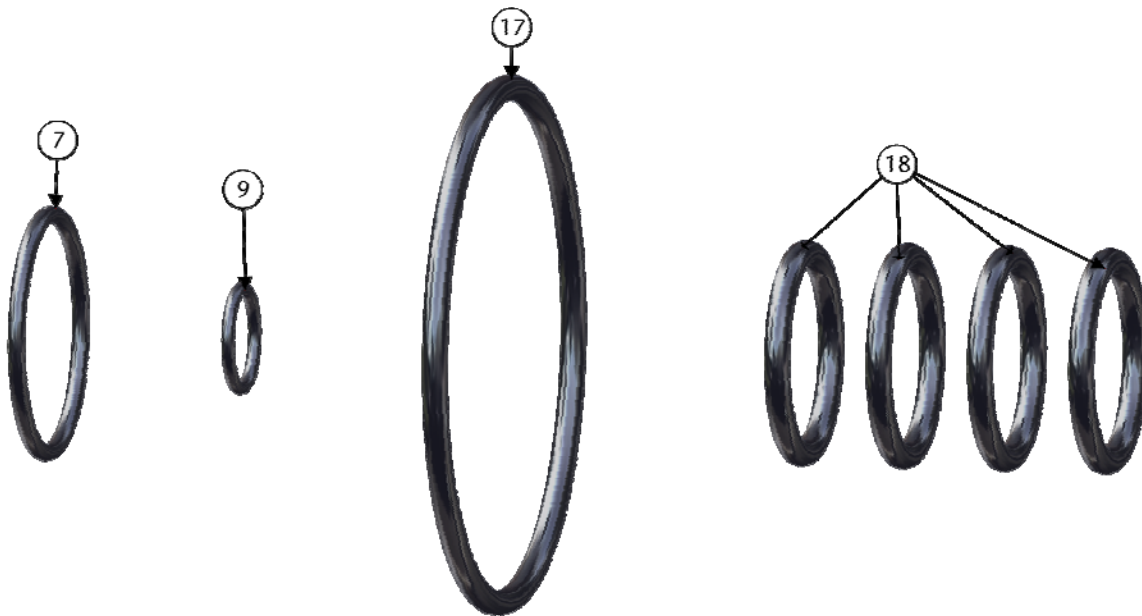
FIXED NOZZLE (6)

Visually inspect the discharge nozzle seal area and nozzle seal surface for signs of wear or damage. Replace the nozzle if damage exists. Visually inspect the fluid discharge hole for erosion or corrosion. Some wear in this area is expected. Any damage in this area that extends deeper than .06" renders the part unstable and it should be replaced.



ELASTOMERIC SEALS (7, 9, 17, 18)

All elastomeric seals should be replaced regardless of condition.



Preventative Maintenance - Replacement and Assembly of Sealing Components:

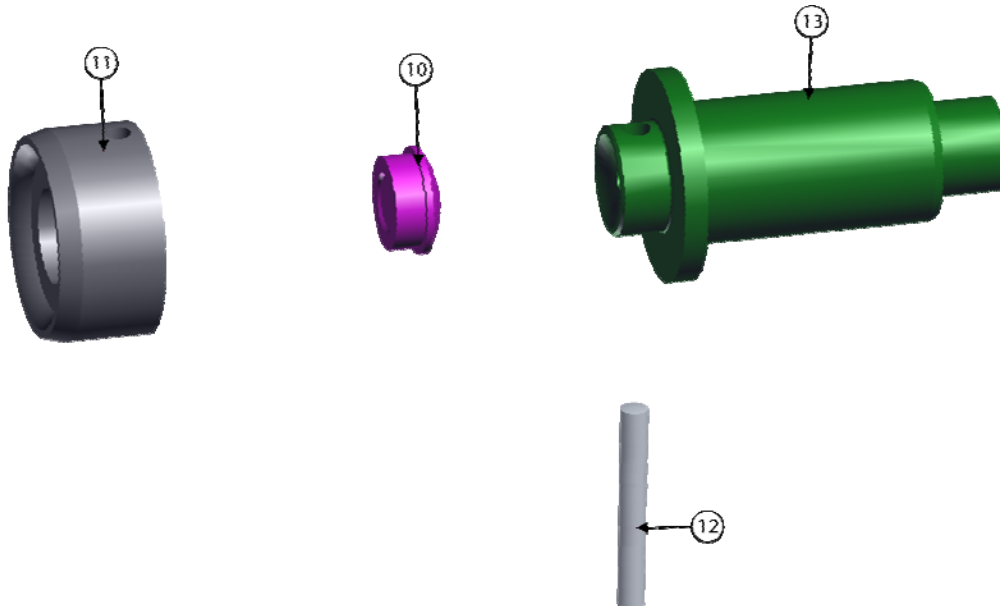
See "ALWAYS REMEMBER" Section on page 12 before assembly.
The reassembly of the valve is in approximate reverse order to the disassembly process.
Lightly lubricate all surfaces prior to assembly.



OBSERVE ALL INSTRUCTIONS, CAUTIONS, AND WARNINGS AS NOTED IN THIS MANUAL. FAILURE TO DO SO CAN LEAD TO EQUIPMENT DAMAGE AND **PERSONAL INJURY OR DEATH!**

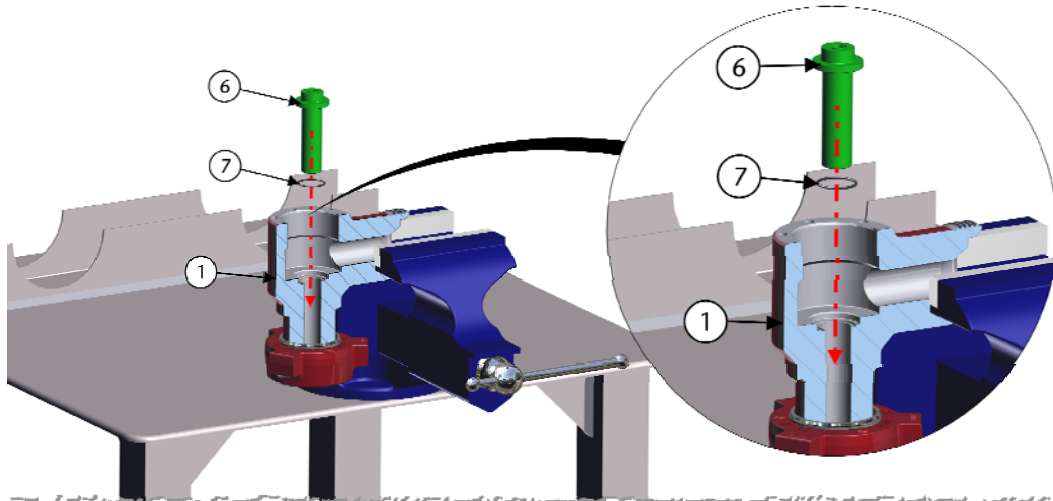
STEP 1

Insert new or polished valve gate (10) into the gate keeper (11). Install the keeper- lower (13) in the gate keeper (11). Insert the taper pin (12) through the gate keeper (11) and the keeper-lower (13) until it rests on the gate keeper (11). Slightly tap the taper pin for security.



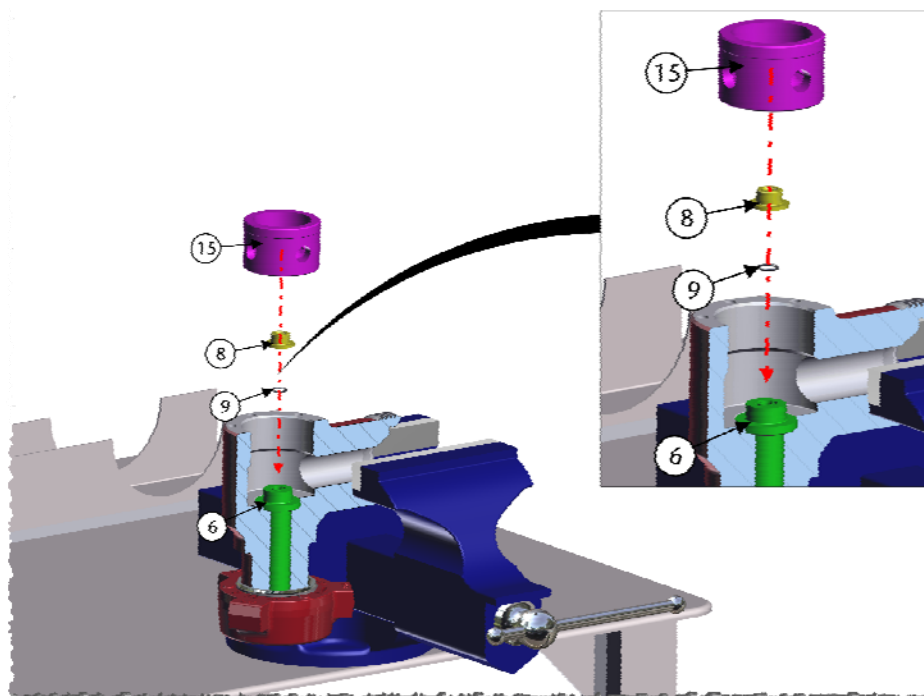
STEP 2

Clamp body (1) in a vise with aluminum jaws as shown. Install a new fixed nozzle seal (7) in the O-ring groove of the body (1). Insert the fixed nozzle (6) into the hole in the body (1) and press the nozzle against the seal (7) by hand.



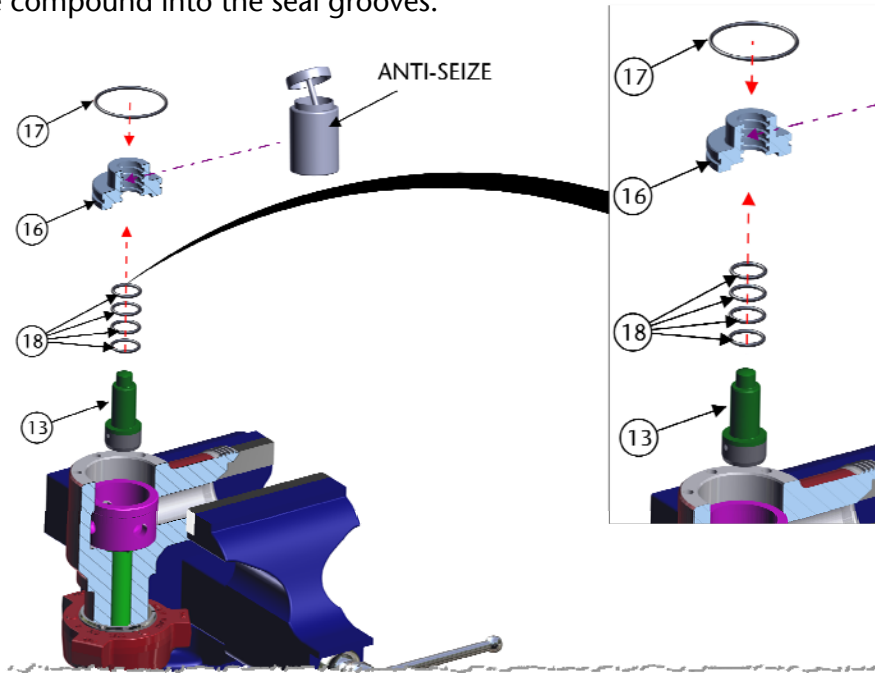
STEP 3

Install new discharge nozzle seal (9) in the O-ring groove of the fixed nozzle (6). Place new or polished discharge nozzle (8) on the top of the fixed nozzle (6). Install the spider-lower (15) into the body (1) so that the sealing surface of the discharge nozzle (8) will appear slightly above the central part of the spider (15).



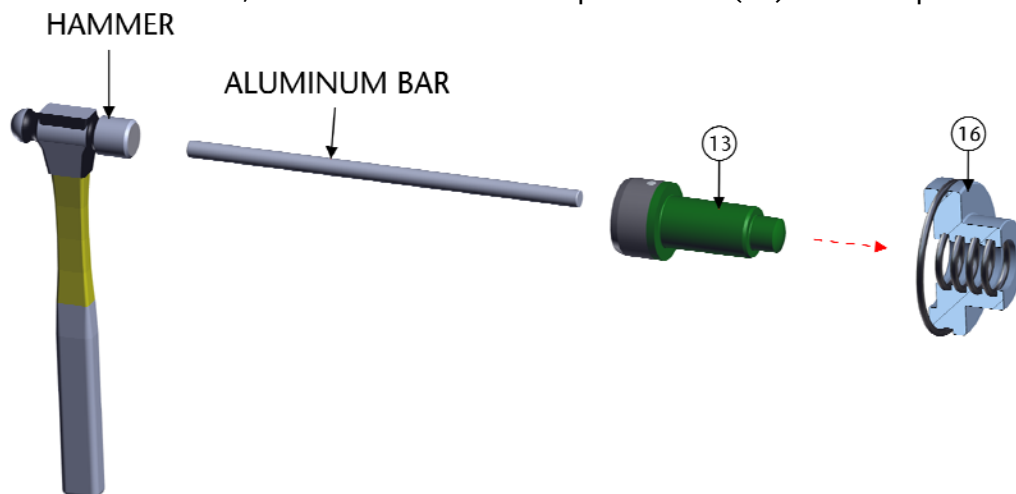
STEP 4

Install a new spider seal – outer (17) and spider seal - inner (18) into the spider – upper (16) and apply a small amount of anti-seize compound into the seal grooves.



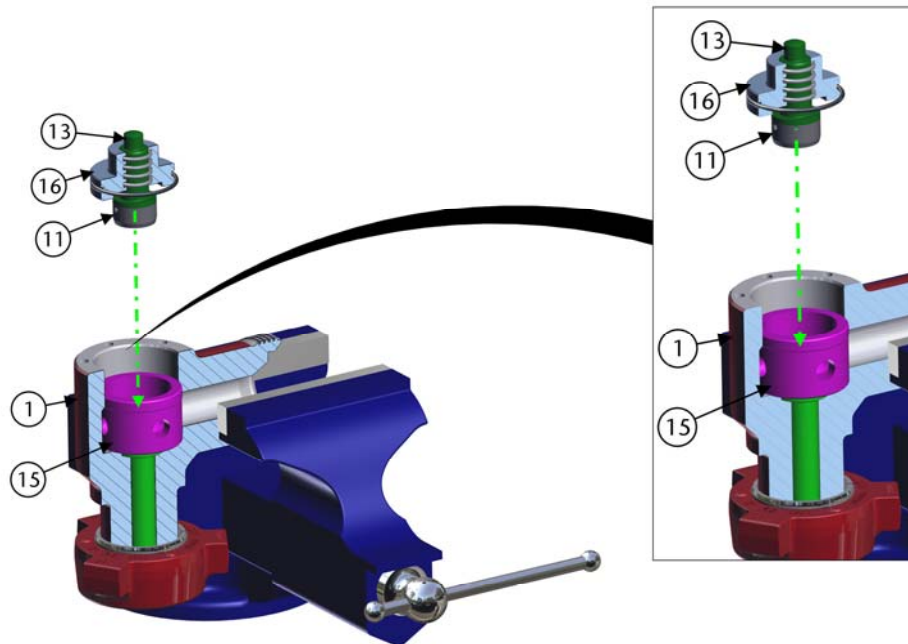
STEP 5

Using an aluminum bar and hammer, insert the assembled keeper – lower (13) into the spider – upper (16).



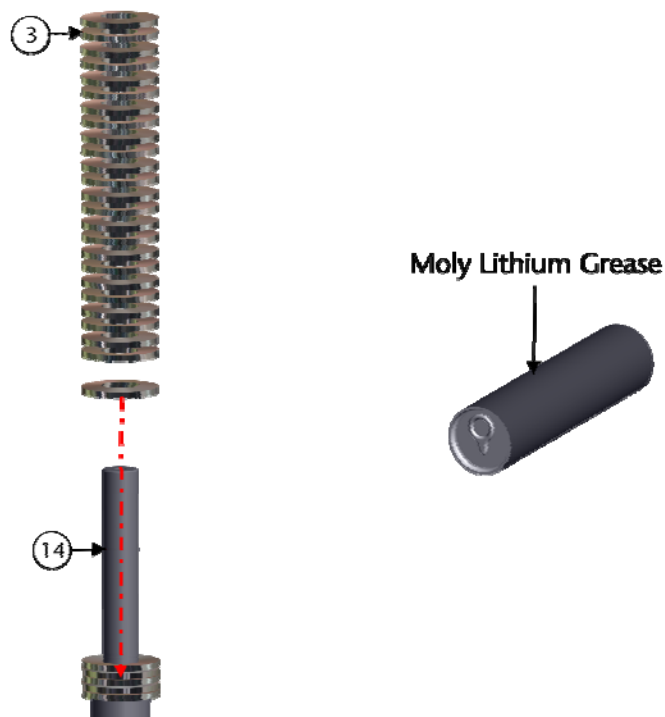
STEP 6

Insert assembled spider – upper (16) into the body (1) until it rests on the spider – lower (15) and press the keeper – lower down by hand (13) until it rests on the gate keeper (11).



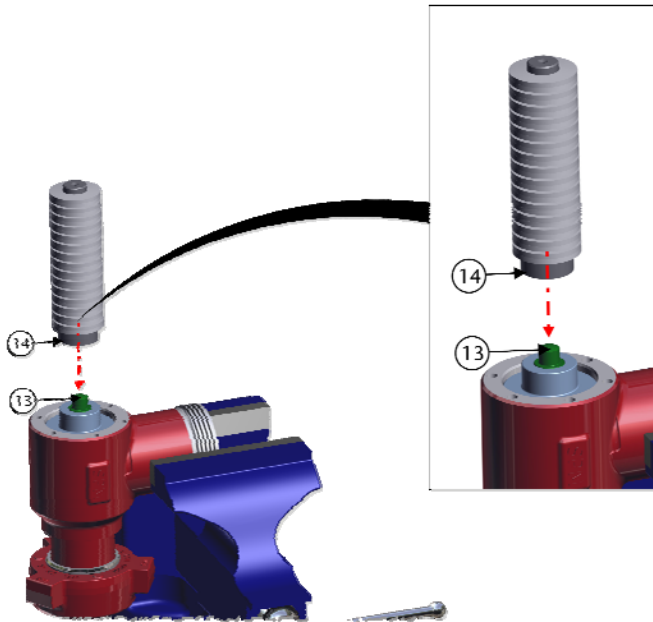
STEP 7

Stack the disk springs (3) on the keeper – upper (14); refer to explode view X for different styles of spring packs. Coat the springs (3) and the keeper – upper (14) liberally with Moly Lithium Grease.



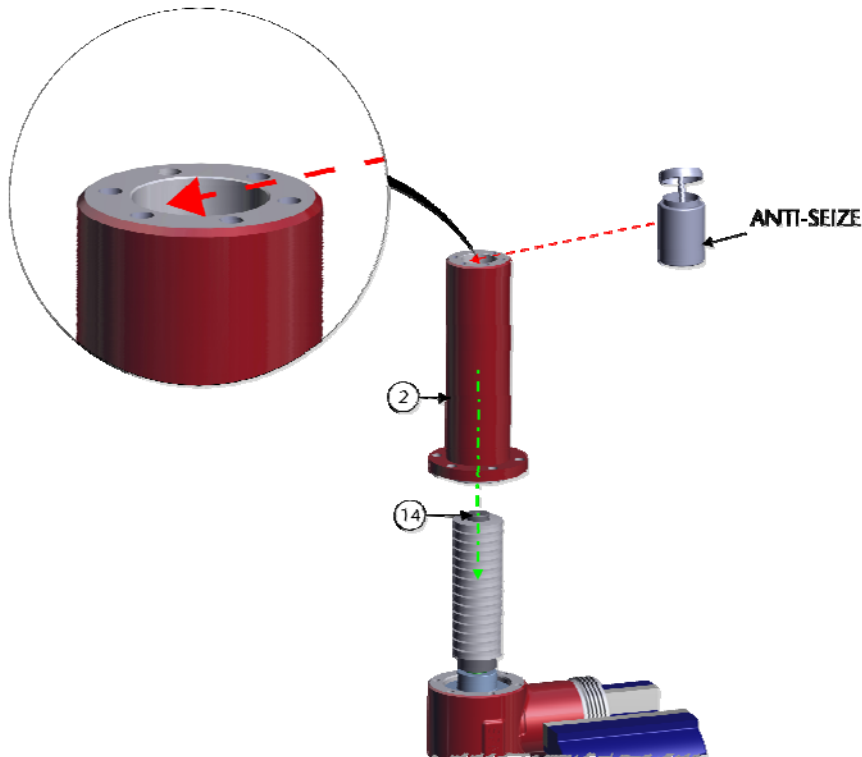
STEP 8

Stack assembly keeper – upper (14) onto the keeper – lower (13).



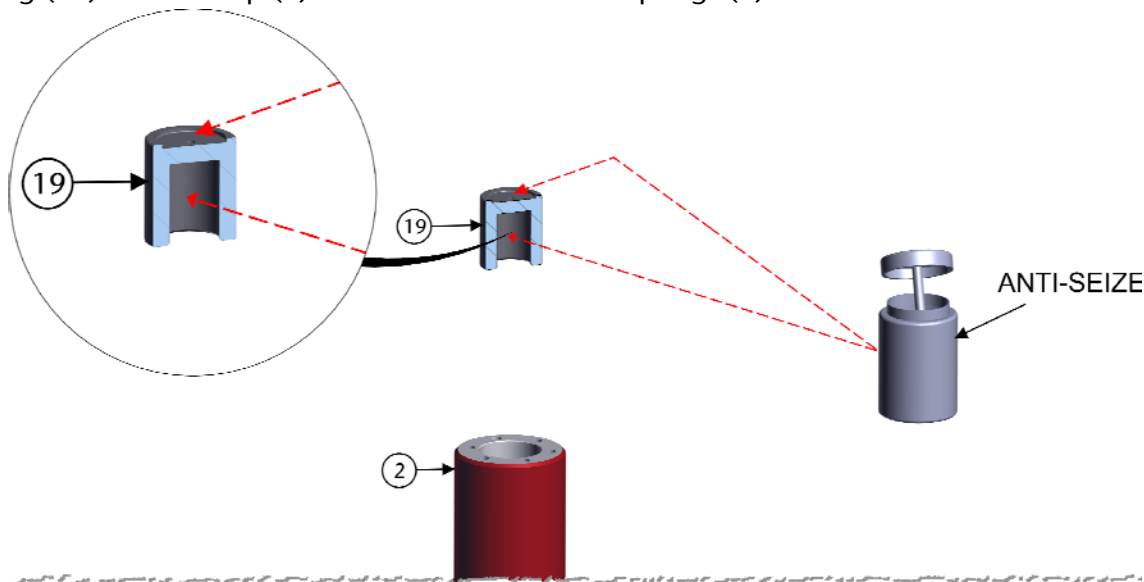
STEP 9

Install the cap (2) on the body (1) so that the top of the keeper – upper (14) will appear within the upper hole of the cap (2). Uniformly apply a small amount of anti-seize compound on the upper hole surface of the cap (2).



STEP 10

Uniformly apply a small amount of anti – seize compound on the inner surface (inside diameter) of the guide bushing (19) as well as the top of the guide bushing, where the adjustment screw will make contact. Insert the guide bushing (19) into the cap (2) until it rests on the disk springs (3).



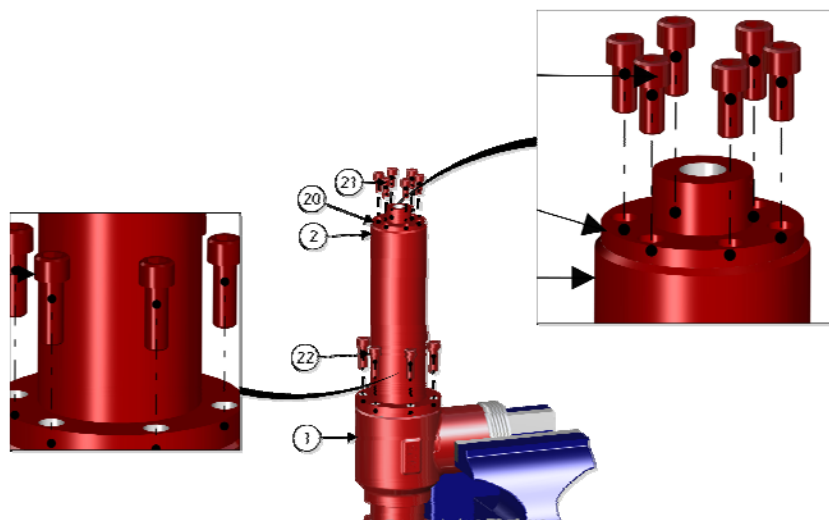
STEP 11

Apply small amount of anti – seize compound to the threads of screw (22). Fully install the cap (2) in the body (1) by uniformly tightening the screws (22). Tighten evenly to 104 ft-lbs.

 **NOTE:** A SMALL GAP MUST BE PRESENT BETWEEN CAP (2) AND BODY (1) AFTER TIGHTENING.

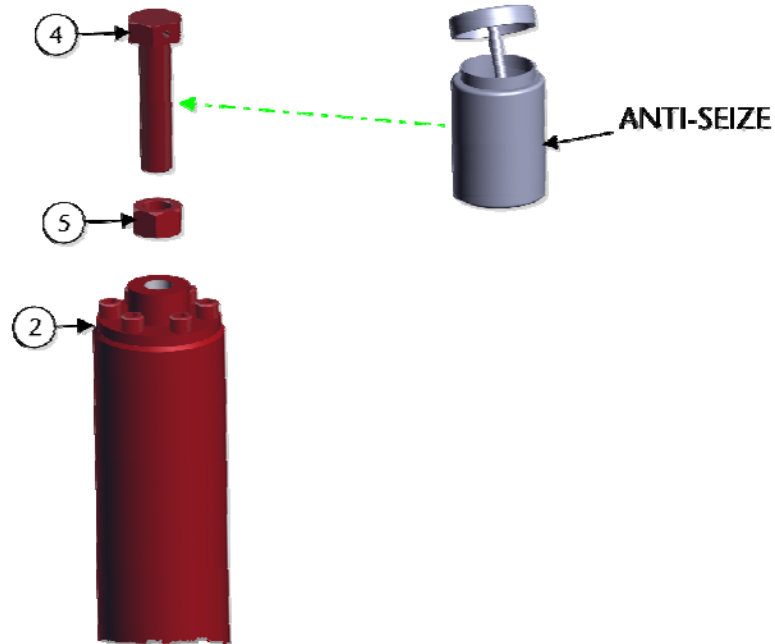
Fully install the flange (20) into the cap (2) by uniformly tightening the screws (21). Tighten to 113 Ft-Lbs. dry or 90 Ft-Lbs. lubricated.

 **NOTE:** NO GAP IS PERMITTED BETWEEN THE FLANGE (20) AND THE CAP (2).



STEP 12

Apply anti – seize compound on the thread of the adjusting screw (4) and draw the lock nut (5) up tight on the adjusting screw; up to the head. Install assembled adjusting screw (4) into flange (20) by hand until it rests on the guide bushing (19). The valve is now ready for pressure testing.



WARNING: THIS MAINTENANCE SECTION IS TO BE ONLY PERFORMED BY A QUALIFIED WIER OIL & GAS SERVICE TECHNICIAN!

Vessel Test Procedures:

Prior to shipment, product testing procedure 4S12497 requires that each emergency relief valve pass a one-time vessel test at 150% it's rated working pressure; then, when conducting subsequent vessel tests on used or re-certified valves, limit the pressure to 100% of rated working pressure as required by 4S12497.

Emergency relief valves should always be vessel tested in accordance with product testing procedure 4S12497. A fully assembled emergency relief valve should NEVER be pressure tested with the outlet discharge port capped or blocked off.

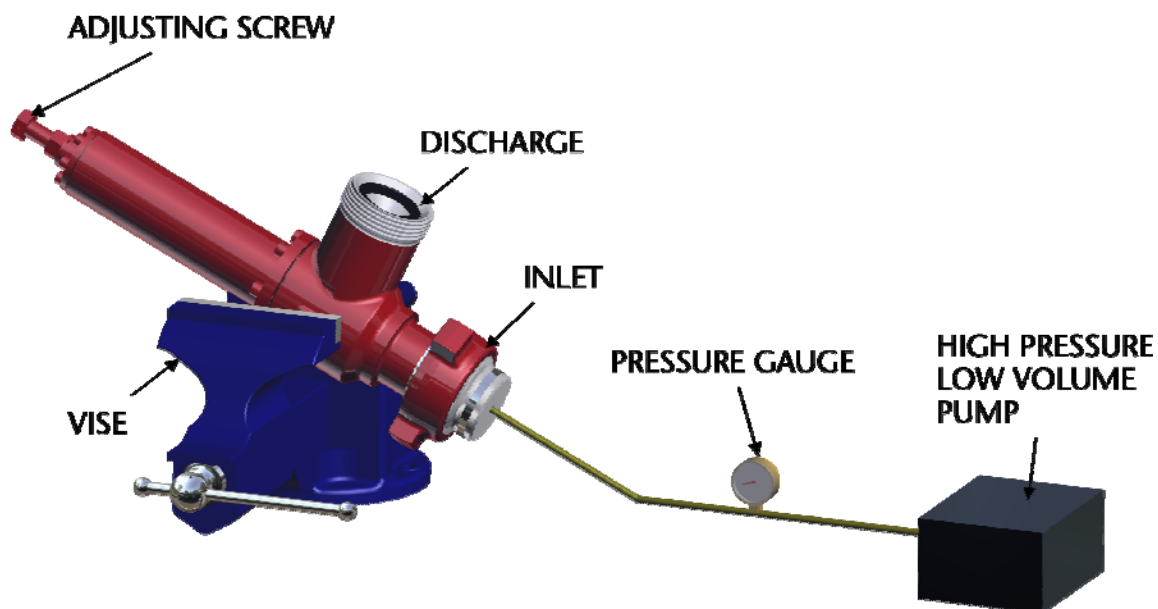


A FULLY ASSEMBLED EMERGENCY RELIEF VALVE SHOULD NEVER BE PRESSURE TESTED WITH THE OUTLET DISCHARGE PORT CAPPED OR BLOCKED OFF!

Below is an excerpt from 4S12497 (Figure 4) regarding the proper vessel testing procedure on used emergency relief valves:

Figure 4

1. Assemble the valve body and install in a vise as shown.
2. Attach valve to testing pump.
3. Fill with water and bleed-off air from the system prior to test.
4. Hydrostatically test by pressuring to 100% of product's designed working pressure.
5. Hold pressure for the duration of time specified in 4S12497, and check for leaks. Assembly is considered to be acceptable if there are no visible leaks, and the pressure drop is within the allowable range specified in 4S12497.
6. Reduce pressure to zero.

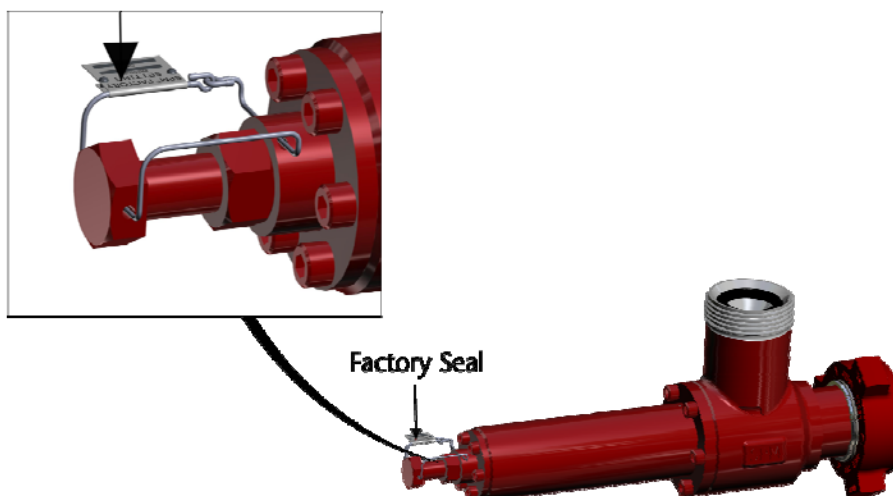


Setting and Adjusting Pressure:

Factory:

The 3" Emergency Relief Valve may be obtained from SPM® as "unset", "preset", or "preset and factory sealed". SPM® bench tests and sets every valve to verify accuracy and function before shipping. If the valve is ordered as "unset", it will be tested for leaks and full pressure capability. The valve is then generally placed at a low (less than 1000 psi) pressure setting for shipping.

For the "preset" and "factory sealed" configuration, the valve is verified to full pressure capability and then set and locked at the required pressure. The "factory sealed" option provides for wire to be fed through the adjusting screw and flange that must be cut before the valve may be readjusted.



Field-Shop:

For field situations where the valve must be adjusted after leaving the factory and a test facility is available, the following procedure applies. Clamp the valve in a vise using the valve body.

If the valve is reassembled with new springs, screw and unscrew the adjusting screw three times: 16 revolutions for 5K ERV and 23 revolutions for 15K ERV. Rotation has to begin when the adjusting screw is hand tightened against the guide bushing.

The set pressure can then be adjusted by rotating the adjusting screw either counterclockwise (L/H) to lower pressure or clockwise (R/H) to raise pressure.

It should be noted that this is a direct acting relief valve that uses the spring forces to balance the fluid pressure. Consequently the forces needed to adjust the pressure can be quite high.

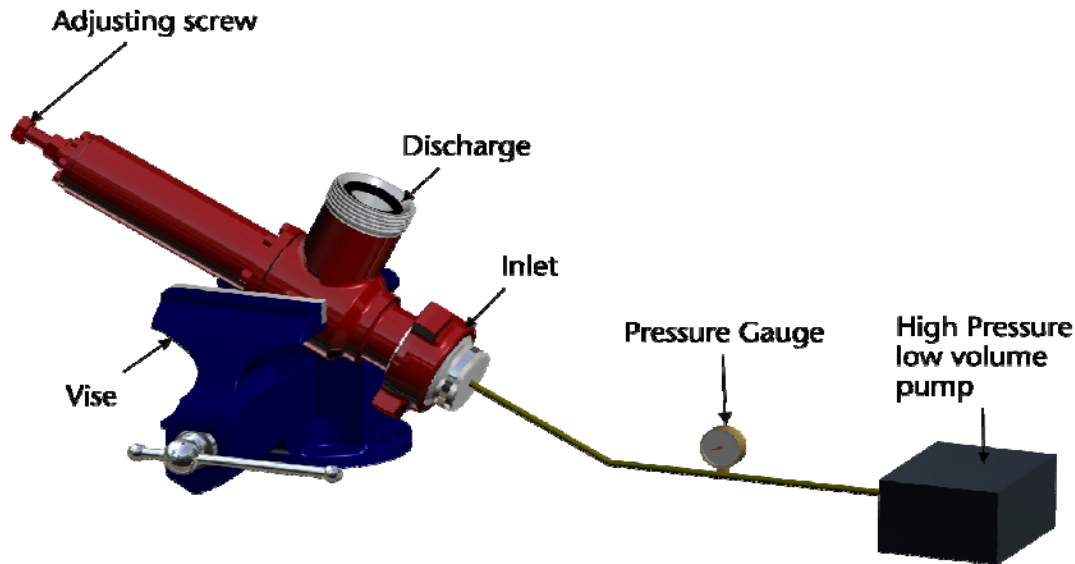
The pressure source should be a low volume liquid pump with sufficient pressure capacity to meet the set value requirements. The medium should be water or inert hydraulic oil suitable for this purpose.

CAUTION

All air must be purged from the valve and lines prior to building pressure. Trapped air becomes explosive under pressure, should the valve fail.

A recommended practice is to adjust the valve to full open (no pressure) prior to reset. The valve should be oriented with the inlet end slightly down and the discharge port turned up.

Field-Shop (Cont.):



By fully loosening the adjusting screw, the fluid will pass from the pump to the valve and purge the system of air. The valve pressure setting can then be raised by rotating the adjusting screw clockwise (R/H) and monitoring the gauge reading until the desired level is achieved. Once the pressure is set, the lock nut should be drawn tight clockwise while holding the adjusting screw steady.

The procedure of rotating the adjusting screw acts to vary the load that the disk springs apply to the valve gate and discharge nozzle. With a given valve setting, the springs will cause the valve gate to bear against the discharge nozzle with a given force. The hydraulic pressure of the system works against the bottom surface of the gate defined by the circle with a diameter equal to the average diameter of the contact ring of the discharge nozzle.

If the system pressure generates a force on the gate lower than the spring force applied to its top, the gate will remain seated. However, if the system pressure creates a force higher than the spring load, the gate will lift off the nozzle and allow fluid to discharge.

If the valve fails to hold pressure, the problem is generally one of the following:

- a.) Contamination between gate & nozzle holding the gate off the nozzle.
- b.) Damaged gate and nozzle.
- c.) Damaged discharge nozzle seal or fixed nozzle seal or both of them.

To correct the problem, follow the instructions in Service & Maintenance, for Disassembly, Inspection and Reassembly.

Setting and Adjusting Pressure (Cont.):

Field – On Site:

Generally, at the start of a Frac Job, the customer will want to verify that the ERV will relieve at the intended pressure. This maximum pressure may be arrived at by the condition of the wellhead or downhole equipment, or it may be dictated by the limits of the treating iron. It may also be arrived at for other reasons. Consequently, each job is likely to vary in the required setting of the ERV.

The valve can be initially set by counting the number of turns on the adjusting screw to get an approximation of desired set pressure. The valve can also be preset at the shop to the desired level.

The operator will then slowly bring his pump(s) on line and note at what pressure flow rate begins. This is the set pressure. If convenient, he can disconnect the discharge line of the valve and visually note at what pressure fluid discharges from the valve. This is the set pressure.



DO NOT LET FLUID FLOW THROUGH THE VALVE WITH THE VALVE SET OPEN. DAMAGE TO THE VALVE WILL OCCUR.

If the valve is not at the preferred setting, an increase or decrease in setting is accomplished by turning the adjustment screw. Then the pump is brought on again to confirm the right setting. By following this procedure, the serviceman and company man have confidence that an exact setting is affected and that the valve will perform as intended.



Troubleshooting Guide:

TROUBLESHOOTING GUIDE

Always follow existing SPM® procedures concerning identifying equipment for inspection, and removing equipment from service. The following is intended as a general guide in helping resolve most problems encountered in repairing emergency relief valves. If problems not covered here are encountered, contact Weir Oil & Gas for assistance at 1-800-342-7458.

SYMPTOM		PROBLEM		SOLUTION	
1	Rapid erosion	a)	Used as continuous bypass	a)	Use only as an emergency pressure relief device
		b)	Used beyond rated capacity	b)	Install sufficient quantity of valves to meet capacity requirements
2	Shuddering (Rapid opening and closing)	a)	Damaged gate (or gate & nozzle)	a)	Replace damaged parts
		b)	Relief valve located too close to pump's discharge	b)	Relocate Pressure Relief Valve. Refer to service literature for information on proper location.
3	Loss of pressure (Valve does not seal or loses fluid through discharge)	a)	Valve not set properly	a)	Set valve correctly.
		b)	Damaged gate & Nozzle	b)	Replace damaged parts
		c)	Damaged discharge nozzle or fixed nozzle seals	c)	Replace seal
		d)	Cap not installed properly	d)	Fully install the cap #Item 2 in the body #Item 1 by uniformly tightening the screw #Item 22. Tighten evenly to 104 Ft-lb (lubricated). A small gap must remain between the cap and body
4	Valve leaks through weephole or between valve body and cap	a)	Damaged inner or outer or both Spider seals	a)	Replace damaged seals
5	Valve releases higher or lower than intended relief pressure	a)	Valve set incorrectly	a)	Reset valve to desired pressure per instructions in Section VII
		b)	Disk springs not installed correctly	b)	Reinstall disk spring pack. Reset valve



SECTION IV: Service and Support

Service Center Order Information:

Weir Oil & Gas stocks a large inventory of genuine original equipment replacement parts. In order to expedite a parts order and avoid any delays, please provide the following information with your order:

- The part number and description (refer to drawings and parts lists in this section) of each item ordered.
- The quantity of each part, kit, or assembly ordered.
- The model number and serial number.
- Your purchase order number.
- Specify method of shipment, complete shipping address, complete billing address and telephone number at the destination of the shipment.

Parts and service may be ordered through the following locations.

Weir Oil & Gas

601 Weir Way
Fort Worth
TX 76108
USA

Tel: (817) 246 2461
Fax (817) 246 6324
www.weiroilandgas.com

